The
Tropical Agriculturist
March, 1928.

Editorial.

The Imperial Agricultural Research Conference.

IN the issue of the *Tropical Agriculturist* for September, 1927, reference was made to the Imperial Agricultural Research Conference and to the representation to it from Ceylon.

The Report of the Secretary to the Conference has now come to hand and it is thought that the reproduction of this report together with the memoranda which were submitted to the Conference from Ceylon will be of general interest. The importance of the Conference has been fully recognized by all units of the Empire and in view of the forthcoming visit of the Rt. Hon'ble Mr. Ormsby Gore, M. P., Under-Secretary of State for the Colonies, to the East, charged with the mission of investigating the work which is being done in the several colonies, it seems desirable that the general findings of the Conference should be made available as early as possible.

The organized development of the tropical countries is essential in the interests of the vast populations of those countries and such development cannot proceed upon sound lines unless it is based upon ascertained facts accumulated as the result of research.

The general health of the people is the first consideration and the advances made in tropical medicine in recent years as the result of patient research have been considerable and have been recognized by all administrations. The application of this knowledge by the health and sanitary sides of medical departments is having considerable stress laid upon it by all at the present time and great improvements in general health and in the lessening of infantile mortality are bound to result.

Similarly the economic or material welfare of the people depends upon agricultural or industrial development. In the

tropics generally, agricultural development is most important and in agriculture the value of research work is beginning to be recognized. Research work is necessary in order that actual facts may be secured—facts which are essential for any constructive policy of rural or agricultural development. Land schemes and colonization settlements have failed in a number of cases in the past because accurate data in regard to crops and their requirements and more particularly in regard to the economics of crop production were completely ignored. The agricultural research worker has the world over demonstrated his value and any programme of development not guided by research and based upon the data obtained thereby is doomed to ultimate failure.

Established agricultural industries also must make provision for research if they are to meet the increasing competition with which they are faced. All industries are working towards greater efficiency, and in this competition those which are content with inefficient methods are bound to suffer in the world's markets. Efficiency in industry is only secured as the result of patient and extended research investigations and it is therefore to be hoped that Ceylon will before long have decided that its chief agricultural industries shall be provided with adequate research schemes.

The wider and more important aspects of agricultural research were dealt with by the Conference. The axiom that science knows no bounds was recognized throughout and considerations were given to the co-ordination of research work throughout the Empire. The proposals for co-operation between workers in different branches, the proposed establishment of a chain of Central Research Stations and the importance of a Central clearing house were dealt with, and are all worth the close attention of Ceylon.

Ceylon has an important rôle to play in the agricultural research work in the East, and its central position, its great variety of crops and its good climate mark it out as a suitable centre for one of the Central Stations.

The result of research must be translated into practice. Progress in this direction depends largely upon the attitude of the agriculturists themselves. Further teaching of biological sciences in the secondary schools is essential and a complete overhaul of primary education with teaching directed towards rural science necessary. A beginning is now being made with the latter. Will there be a response in connexion with the former? If the biological sciences occupied an important position in our secondary schools more rapid agricultural progress would be assured. It is therefore to be hoped that this matter will not be overlooked by the Educational authorities.

Original Articles.

The Imperial Agricultural Research Conference.

Empire Co-operation in Agricultural Research.

W. R. BLACK, B.Sc.,

Secretary, Imperial Agricultural Research Conference.

IN October and early November of 1927, there was held in this country a conference—the first of its kind—between workers conducting research in agriculture, and officers responsible for the administration of such research, throughout the British Empire, the object being to secure a greater measure of co-operation between such workers and officers than had hitherto been achieved. The proposals for holding such a conference originated with the Agricultural Research Council of Great Britain in July, 1925, and the proposal received the approval of the Imperial Conference, 1926, which urged the respective Governments of the Empire to give it the fullest possible support. The Imperial Conference, 1926, recommended that the Ministry of Agriculture and Fisheries should be responsible for organizing the Conference, and this responsibility was willingly accepted by the Ministry.

Organization of Conference.—To assist the Ministry in the work of organization, the Minister, the Rt.Hon. Walter Guinness, M.P., appointed an Organizing Committee for the Conference (of which the Rt. Hon. Lord Bledisloe, Parliamentary Secretary to the Ministry, was Chairman), consisting of representatives of Government Departments in the Mother Country and of the Dominions and Colonies.

The Organizing Committee were fortunate in securing the permission of the Lord Great Chamberlain to the use of the Grand Committee Room in Westminster Hall, Houses of Parliament, for the plenary sessions of the Conference, and in obtaining, from His Majesty's Office of Works, ample accommodation for the numerous Committees of the Conference. In order that the

delegates might be made aware of the progress achieved in agricultural research in the Mother Country since the war, a tour of visits to research institutes in England and Wales, Scotland, and Northern Ireland was planned; the arrangements for the tour were facilitated to a remarkable degree by the readiness with which the authorities responsible for the conduct on research into agriculture and allied subjects offered their co-operation. The principal centres visited were Cambridge, Billingham, Edinburgh, Aberdeen, Belfast, and Oxford. Offers of hospitality were received from Governments, Universities, and civic authorities in such measure that the Committee were able to arrange a very full programme of entertainment.

Acknowledgment must be made, in particular, to the Government Hospitality Fund, the Board of Agriculture for Scotland, the Government of Northern Ireland, the Universities of Cambridge, Edinburgh, Aberdeen, Belfast, and Oxford, the Lord Mayor of London, the Edinburgh Corporation, the Aberdeen Corporation, the Imperial Institute, and Synthetic Ammonia and Nitrates, Ltd. Reference must also be made to the arrangements by the L. & N.E. Railway Company for the comfort of the delegates while travelling, these including the placing of a special train at the disposal of the Conference without extra charge, the provision of meals, and co-operation in the provision of a special cinema film exhibit on the train.

The Organizing Committee also drew up an agenda which proved to be substantially that adopted by the Conference: and arranged for the collation of the material forwarded by the different Governments and the preparation of a large number of documents which it was considered would be of value to the Conference in its deliberations.

Countries and Departments Represented.—The Conference was attended by some 200 delegates and representatives. The following Dominions, Colonies, etc., were represented: Canada, Australia (Commonwealth, New South Wales, and Queensland), New Zealand, Union of South Africa, Irish Free State, Southern Rhodesia, India (& Burma, Madras & Punjab), Barbados, British Guiana, Ceylon, Cyprus, Federated Malay States and Straits Settlements (and the Rubber Research Institute of Malaya), Gambia, Gold Coast, Iraq, Kenya, Leeward Islands, Malta, Mauritius, Nigeria, Northern Rhodesia, Nyasaland, Palestine, Sierra Leone, Tanganyika (and Amani Research Institute), Trinidad (and Grenada, Windward Isles, and the Imperial College of Tropical Agriculture), Uganda, Zanzibar, and the Sudan. The following Government Departments, etc., in this country sent delegates: The Ministry of Agriculture and Fisheries (including the Royal Botanic Gardens, Kew), Dominions Office,

Colonial Office, India Office, Empire Marketing Board, Development Commission, Department of Scientific and Industrial Research, Imperial Institute, Board of Agriculture for Scotland, Ministry of Agriculture for Northern Ireland, Department of Overseas Trade, Forestry Commission, Medical Research Council, Imperial Bureau of Entomology, Imperial Bureau of Mycology, Overseas Settlement Department, Board of Education, University Grants Committee, Scottish Education Department, Linen Industry Research Association, Empire Cotton Growing Corporation, the High Commissioners for Canada, South Africa, Australia, New Zealand, Southern Rhodesia, the Irish Free State, and India, and the Agricultural Research Council of Great Britain.

The Conference was opened by the Rt. Hon. Walter Guinness, M.P., on October 4th, 1927. Thereafter, the Conference appointed the Rt. Hon. Lord Bledisloe, Parliamentary Secretary to the Ministry of Agriculture and Fisheries, as Chairman, and the Rt. Hon. W. G. Ormsby-Gore, M.P., Lord Lovat, and Major Elliot, M.P., Vice-chairmen. The Secretariat of the Conference, under the direction of the writer and Mr. E. M. H. Lloyd, of the Empire Marketing Board, was provided by the Ministry of Agriculture and Fisheries and the Empire Marketing Board.

Message from His Majesty the King.—The first act of the Conference was to send the following message of greeting to His Majesty the King:—

> "The Imperial Agricultural Research Conference, at their first meeting, desire to offer to Your Majesty an assurance of their loyal devotion and of their resolve that the present Conference shall be instrumental in promoting friendly co-operation throughout Your Majesty's Empire among all those who are engaged in the advancement of agricultural science and its application to the needs of the agricultural industry."

His Majesty's gracious reply was in the following terms:—

> "I have received your message with great pleasure. Please convey to the Conference an expression of my sincere thanks and of my interest in their work, of which I realize the great importance to the prosperity of all parts of the Empire."

Agenda.—The most important subjects in the agenda were adjudged to be those of an administrative character, viz:—

(1) The Recruitment, Training and Interchange of Workers.

(2) The Establishment of a Chain of Research Stations.

(3) The Establishment of further Imperial Bureaux; and the Interchange of Information.

(4) Periodical Conferences.

After discussion of each of these subjects by the full Conference, they were referred to an Administrative Commission which, in turn, set up three Committees to deal with them (subjects 3 and 4 being taken by one Committee). The chairmen of these three Committees were (1) Mr. F. L. Engledow, (2) Major W. Elliot, M.P., (3) Sir R. Greig.

The specialist questions, submitted to the Conference, were classified as follows, and their consideration was referred to specialist Committees with the chairmen indicated:—

A. Animals.

(1) Veterinary Science (Chairman: Sir A. Theiler).
(2) Animal Nutrition (Chairman: Professor T. B. Wood).
(3) Animal Genetics (Chairman: Dr. F. A. E. Crew).
(4) Dairying (Chairman: Dr. S. S. Cameron).

B. (5) **Soils and Fertilizers** (Chairman: Sir John Russell).

C. Plants.

(6) Plant Pathology (including Mycology) Chairman: Sir D. Prain).
(7) Plant Breeding (Chairman: Professor A. E. V. Richardson).
(8) Fruit (Chairman: Mr. W. T. Macoun).

D. (9) Entomology (Chairman: Dr. G. A. K. Marshall).

E. Economics.

(10) Agricultural Economics (including marketing) Chairman: Mr. C. S. Orwin).
(11) Preservation and Transport (Chairman: Mr. H. T. Tizard).

Thirty-three memoranda were submitted on administrative questions and 91 on specialist questions. These were grouped into 15 documents printed and stencilled, the memoranda being prefaced by precis of their contents and a general review of the subjects dealt with. Various other documents were specially printed for the Conference, the chief of which were*:—

(1) A review of Agricultural Research Work in Great Britain and Northern Ireland;
(2) A review of Agricultural Research Work in the Overseas Empire;
(3) A list of Agricultural Research Workers in the British Empire;
(4) Abstracts of papers on Agricultural Research in Great Britain during the period of October, 1926, to March 1927.

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* A limited number of copies of these are available and may be obtained from the Secretary of the Conference; the charge for No. 5 is 1s.; the rest are free.

(5) A description of an exhibit on the History of Agricultural Literature specially prepared for the conference by the British Museum.

The following is a very short summary of the recommendations made by the Conference.

Chain of Research Stations.—The establishment of central tropical and sub-tropical research stations should be governed primarily by the ascertained needs of Empire research in particular fields of Agriculture, rather than by considerations of geographical distributions. These stations should be located in territories affording specially advantageous conditions for the study of each problem. They should in the main confine themselves to " long range " and " wide range " research.

The work of the central research station should not impair or replace the scientific work of any Agricultural Department in its proximity. In providing advice, it should limit itself to that directly resulting from its research activities; in special conditions it might serve as a convenient base of operations for a travelling advisory staff. No teaching work should be undertaken except in so far as the advanced instruction of a limited number of post-graduate students can be undertaken with advantage to the research work in progress.

A total superior staff of some 10 highly qualified men will probably prove to be the minimum staff of a central research station. Besides adequate capital expenditure, an annual maintenance expenditure of the order of £20,000 per annum must be envisaged. If there is no reasonable prospect of such staff and funds being provided, the establishment of a station should be postponed. Contributions might be expected from both public and private source, and, besides money, might include gifts of land and in kind.

The form of control of a central station must be such as to ensure that the work of the institution shall not be diverted from a progamme of free research.

A programme of establishment of central stations was indicated by the Conference. Most of these must eventually be in the Colonial territories. So far as these territories are concerned, the development or modification of the programme is a matter primarily for the proposed Colonial Agricultural Research Council.*

The plan for a station in Northern Queensland was noted by the Conference; the establishment of further stations in the self-governing parts of the Empire must be a matter for further consideration by the Governments concerned.

* The Establishment of an Agricultural Research Council to co-ordinate agricultural research in the Non Self-governing Dependencies was recommended by the Committee on Agricultural Research and administration of the Non-Self-governing Dependencies.

The establishment of a central station for diseases of animals is of great importance, but presents difficulties. As a practical measure, an existing station should be expanded for the purpose, and such expansion of the South African Station at Onderstepoort is suggested.

The need for a central research station for irrigation problems should be further explored; and a sub-committee of the Civil Research Committee could suitably be appointed to report upon the subject in its various aspects.

Bureaux and Interchange of Information.—The functions of a clearing station should be to collect, collate and disseminate information of a scientific and technical character; to reply to inquiries on scientific and technical problems from agricultural departments and scientific workers in any part of the Empire; and, particularly, to facilitate intercourse among groups of workers on closely allied problems.

For the present, the organization of additional laboratories for attacking Imperial problems is considered to be outside these functions. Such stations are best established in conjunction with existing research institutions. They should be commenced in small numbers and on a modest scale.

The establishment of Imperial clearing stations, on the scale of bureaux, is recommended for *Soil Science* (at Rothamsted Experimental Station), *Animal Nutrition* (at Rowett Research Institute, Aberdeen), and *Animal Health* (in London). The last should include and absorb the section dealing with Animal Diseases now comprised in the Bereau of Hygiene and Tropical Diseases.

The establishment of Imperial clearing stations on a smaller scale—" correspondence centres "—is recommended for *Animal Genetics* (at the Animal Breeding Research Department, Edinburgh University), *Agricultural Parasitology* (at the Institute of Agricultural Parasitology, London School of Hygiene and Tropical Medicine), *Plant Genetics* (Cambridge Plant Breeding Institute for plants other than herbage plants, the latter to be dealt with at the Welsh Plant Breeding Station), and *Fruit Production* (at the East Malling Research Station).

The Imperial Institute and the Royal Botanic Gardens, Kew, should continue the useful work they are doing in acting as Imperial clearing stations in *Economic Botany*, and also in other directions in the case of the former Institute. As regards *Dairying*, it might be desirable to explore the best means of securing systematic collection and dissemination of information on the subject, and (in this connexion) the question of the publication of an Empire journal on dairying research. On *Preservation* and

Transport the Low Temperature Research Station should undertake the duty of arranging for the interchange of lists of new and useful publications on those subjects. The establishment of a single publicity bureau for the Empire is not recommended, nor is a central clearing station for work other than that specified for the Imperial bureaux and correspondence centres.

The funds of the new Imperial bureaux and correspondence centres should be administered by an authority on which the Governments of the Dominions and India and certain Government Departments in the Mother Country should be represented. In addition each bureau should be advised by a technical committee nominated by the Governments concerned and reporting to the financial supervisory body; correspondence centres should, as far as practicable, also be conducted on these lines.

Uniformity in methods of indexing, recording and publication should be secured by bureaux and correspondence centres.

The sums of £13,000 for Imperial bureaux and £7,000 for correspondence centres, in all, per annum, for five years in the first instance, should be sufficient for the programme outlined.

A " List of Agricultural Workers in the Empire " prepared for the Conference should be revised and periodically circulated. A general survey of Agricultural Research in the Empire, prepared for the Conference, should be revised on the occasion of the next Conference.

The Conference will meet again in Australia in 1932. Specialist and regional conferences are desirable; the initiative in convening them should be left to the authorities immediately concerned.

Recruitment and Training.—The advance of agriculture demands that every effort should be made to attract candidates of the highest class and to equip them with the best possible training.

For the specialist officer, a sound honours training in the pure sciences, including at least one biological subject, is essential. Equally essential is such a knowledge of agriculture as will enable him to appreciate clearly the rôle of science in agriculture.

For the agricultural officer, wide agricultural knowledge, a practical outlook and administrative ability constitute the first requirements. Next come scientific knowledge adequate for the full utilization of scientific results in agriculture and for close collaboration with his specialist colleagues. Character and health are of first importance.

Recruitment for a Colonial Agricultural Service.—Adequate emoluments, facilities for work, and satisfactory superannuation arrangements are necessary in the interests of recruitment as well as for the ultimate efficiency of the Service.

The nature, amenities and prospects of the Service must be made more clearly and widely known.

Scholarships to boys still at school are not recommended. School-leaving scholarships to the universities should be considered. Inducement in the form of scholarships of any kind is wise and fair only if the Service be made to provide really good careers. A flourishing agriculture throughout the Empire is the best guarantee of a market for Empire manufactures. It is, therefore, suggested that the founding of scholarships schemes to promote agriculture deserves the attention of all industries, agricultural and other.

The predominance of the physicial sciences over the biological sciences in all educational institutions, from the elementary schools to the universities, is one of the gravest difficulties in the supply of officers for the Agricultural Service. It is essential to view this difficulty as one of education as a whole, not merely of agricultural education. The help of educational authorities should be sought without delay.

The Colonial Office Agricultural Scholarship Scheme.—The existing scheme,* strengthened and suitably modified, may be expected to meet requirements for the present, provided that it be extended to cover Veterinary Science. The scholarship scheme will be greatly facilitated if Colonial Governments supply advance warning of their staff requirements.

The Training of Colonial Office Agricultural Scholars.—The broad object of post-graduate training is to develop the scholar into the officer. Systematic training courses cannot be prescribed. It must be left to the universities and colleges to ensure that scholars have every opportunity to profit from instructional facilities and to develop themselves to the standard desired in the Service. Every possible step must be taken to free from unnecessary difficulties the share of universities in training scholars. Training should include some investigational work, and scholars should, whenever possible, be under a supervisor, himself engaged in investigation and with experience of teaching.

The training should continue to be normally one year in Great Britain and one in a tropical country, *e.g.*, at the Imperial College of Tropical Agriculture, Trinidad. Careful co-ordination of the work in these separate years should be effected. Short specialist courses should be avoided and soundness in fundamental be the first aim. Provisions for training must be flexible, and the personal interest and services of the body administering the scheme for scholarships and training are the real guarantee of success.

An Imperial Basis for Recruitment and Training.—Scholarships and post-graduate training on an Imperial basis are impracticable. Scholarships and appointments to the Colonial Agricultural Service are, it is learnt with pleasure, already open, in

* The Colonial Office award annually a number of post-graduate scholarships in agriculture and agricultural science with the object of creating a pool of properly qualified candidates from which the vacancies in the Colonial Agricultural Departments can be filled. Further particulars are contained in a leaflet issued by the Ministry or may be obtained from the Private Secretary (Appointments), Colonial Office, 38, Old Queen Street, S.W.1.

practice, to suitable men from all parts of the Empire. The stimulation of further interest in, and recognition of, the importance of science in agricultural development should again be urged upon all the Governments of the Empire.

Study-Leave.—Facilities for study-leave are essential to the success of an agricultural service. Existing facilities are, in general, inadequate. Specific financial provision and appropriate increases in staff to make study-leave possible are an urgent necessity.

Study-leave should always have a specific object and be planned with great care for the sake of both the officer and the institution he visits. No central agency is necessary for study-leave arrangements. The bureaux and correspondence centres should be able to facilitate appropriate connections and arrangements.

Interchange of Workers.—Routine interchange is deprecated. Beneficial interchanges will suggest themselves. Interchange would bring many benefits, some of which would reach beyond the strict limits of agricultural progress. Throughout the Empire, existing facilities are inadequate, mainly because of financial difficulties. The help of the appropriate authorities should be sought for this powerful aid to Imperial Agriculture.

Veterinary Science.—The Conference afforded a unique opportunity for the exchange of ideas between veterinary science workers, from which great benefit was derived.

There is need for a clearing-house of information on this subject. Existing facilities are inadequate. A Bureau of Animal Health is proposed to deal with State Veterinary Hygiene and medicine, including legislative measures for the control of animal diseases. The headquarters should be in London. It should incorporate the veterinary activities of the existing Bureau of Hygiene and Tropical Diseases.

Various concessions as regards training are made in different parts of the Empire to students of other sciences who pass over to veterinary training. Adequate specialized professional training cannot be accomplished in less than three years. Every effort should be made to encourage veterinary students to take university degrees, and undergraduate scholarships for the purpose are recommended.

Animal Nutrition.—A bureau for Animal Nutrition should be established at the Rowett Institute.

Animal Genetics.—There is need for further research in animal genetics. The work at Cambridge and Edinburgh on the physiology of reproduction should be developed; the formation of active centres of research in animal physiology throughout the Empire should be encouraged.

Those concerned with live stock breeding and improvement should be given an understanding of genetics. Veterinary officers of the tropical and sub-tropical Colonies and the animal husbandry and live stock specialists of the Dominions should be equipped with an advance knowledge of this subject.

The Animal Breeding Research Department of Edinburgh University should be regarded as the centre for training in animal genetics. The facilities of that department should be amplified and developed. The Colonial Office and the Governments of the Dominions and India should increase the number of post-graduate fellowships, which would enable suitable men to come to that centre. That Department should also serve as an information centre in this subject.

Dairying.—Further study is required of nutritional and breeding problems and of the physiology of milk production. Systematic investigation of the economics of dairy production is of importance. The Empire Governments should encourage the study of the problem of effecting improvements in the flavour, carrying quality, etc., of Empire dairy produce imported into Britain. Greater uniformity should be established throughout the Empire in the official specification prescribed for volumetric glassware used in testing milk and milk products.

The importance of interchange of dairy research workers is stressed. An Empire journal of dairy research is suggested.

Soils and Fertilizers.—There is need for a Soil Bureau, which should be located at Rothamsted Experimental Station.

Memoranda on soil classification, on principles fundamental to fertiliser trials, and on soil deterioration resulting from shifting cultivation, disafforestation, etc., have been or are being drawn up and should be passed to the new bureau for study. Methods of mechanical analysis of soil should be studied by the bureau.

Plant Breeding.—An information organization for plant breeding is recommended. The Cambridge Plant Breeding Institute is suggested as a suitable centre for crops in general, and the Welsh Plant Breeding Station for herbage plants.

Plant Pathology.—Lists of plant diseases should be prepared by the Governments of the Empire. The Imperial Bureau of Mycology should publish and distribute such lists.

The attention of Empire mycologists is called to the preparation by the British Mycological Society of a list of scientific and common names of plant diseases with a view to uniformity in nomenclature. The lists should be circulated to Governments.

The Imperial Bureau of Mycology should prepare a list of books and periodicals to be regarded as the minimum requirements for a Government mycologist; a copy of the list should be forwarded to departments concerned.

The Imperial Bureau of Mycology should draw up a list of institutions to whom the papers and bulletins on mycology and plant pathology published officially should be supplied by Government.,

Funds should be provided for the more extended study of the fundamental nature of virus disease in plants.

Fruit.—The interval between the planting of fruit trees and the time when they come into bearing is so great that the losses consequent on mistakes at an early stage are extremely serious to the grower.

The most pressing questions needing research are those relating to the orchard in its early stages, the most important being: (a) The study of stock and scion and their inter-relations; (b) Surveys of fruit areas to determine the relations of various factors to tree growth and fruitfulness; (c) Chemical studies relating to the tree and its crops; (d) The associated physiological studies. A greatly extended inquiry should be undertaken, and fresh workers should be employed on these studies.

Other questions of importance are the utilization of low-grade fruit, the preservation and transport of fruit, and especially the control of diseases and pests. The provisions of a suitable centre for research and advisory work on fruit preservation and bye-products is urged.

Facilities should be granted for horticultural research workers in the various countries to visit other parts of the Empire.

Entomology.—At the quinquinnial Imperial Conferences of entomologists each entomological service of the Empire should be represented by at least one entomologist. These conferences should occasionally be held at centres other than London. Travelling fellowships for entomologists should be established.

More attention should be paid to the biological control of insect pests. The work of the Imperial Bureau of Entomology in this direction should be further aided. More attention should be given to universities to research and teaching in pure entomology.

Insecticides and Fungicides.—A chemical investigation of insecticides and fungicides should be undertaken by chemists, working in collaboration with entomologists and plant pathologists.

Preservation and Transport.—The time is not ripe for the establishment and development of a clearing house for the interchange, throughout the Empire, of information concerning research into the preservation and transport of agricultural products. Machinery should, however, be set up at the Low Temperature Research Station for the interchange of lists of new and useful publications. It is, separately, desirable to promote the direct reference of problems, preferably by personal conference and collaboration.

All parts of the Empire should undertake the solution of fundamental problems of preservation and transport.

Scientific inspection of overseas cargos should be carried out, on arrival in this country, by representatives of country of origin whenever possible.

Agricultural Economics.—The importance of the study of economic conditions was stressed, as well as the need for Governments of the Empire to secure the services of whole-time agricultural economists on the staff of their Departments of Agriculture. The attention of universities throughout the Empire should be drawn to the dearth of technically trained workers in this subject.

Interchange of information should take place on the technique of cost accounting and methods of farm surveys. Material collected by the two methods of work should serve national and inter-Imperial purposes as well as local needs.

The continuance and development of organized research in marketing, and the supply of market intelligence, is one of the most effective means of benefiting Empire agriculture.

Adequate agricultural statistics should be collected throughout the Empire. The World Agricultural Census of 1930-31 affords a unique opportunity of collecting such statistics.

Next Meeting of Conference.—During the course of the Conference, Mr. Julius, the Head of the Australian Delegation, announced that so strongly did the Government of the Commonwealth of Australia recognise the value of the contact between scientific workers and administrators in agricultural science afforded by such conferences that his Prime Minister, Mr. Bruce, had cordially invited the Conference, should it decide to meet periodically, to hold its next meeting in Australia. The invitation was readily accepted by the Conference, which resolved that its next meeting should be in Australia in 1932.

Following the acceptance by the Conference of the invitation of the Prime Minister of Australia, a message was transmitted from Mr. Coates, the Prime Minister of New Zealand, by the Hon. Sir James Parr, High Commissioner for New Zealand, extending a cordial invitation to all those delegates who attend the next Conference afterwards to visit New Zealand, where they would receive a hearty welcome. Mr. Coates also stated that the New Zealand Government would co-operate with the Government of the Commonwealth of Australia in making the Conference in every way valuable and successful. This invitation was received with great pleasure by the Conference, and Lord Bledisloe, in replying to the invitation, stated that he was sure that as many as possible of the delegates to the next Conference would be most happy to include New Zealand in their itinerary.—*The Journal of the Minstry of Agriculture*, Vol. XXXIV., No. 10, 1928.

Memorandum on Agricultural Organization and its Work in Ceylon.*

F. A. STOCKDALE, C.B.E., M.A., F.L.S.,
Director of Agriculture.

Introduction.

THE organization of research work for agriculture in Ceylon has followed the usual lines of development in Colonial administration. From a botanical garden established in 1810 for the purpose of trials with economic crops under the guidance of practical horticulturists and a change of site to the existing Royal Botanic Gardens at Peradeniya in 1822 development on the scientific side has gradually been extended. The scientific directors of the Royal Botanic Gardens began investigations of the Ceylon Flora and the record of botanical research on the systematic side resulted in a general knowledge of the Flora of the Island. Meanwhile changes in the trend of botanical investigations were not without their influence in Ceylon and definite histological, physiological and ecological investigations were made. The introduction and acclimatization of economic and ornamental plants formed an important part of the work of the Gardens and later requirements demanded provision for the investigation of the commercial possibilities of certain crops, the study of pests and diseases and the physical and chemical properties of soils. This led eventually to the gradual development of the Department of Agriculture which as a Government institution endeavours to stimulate agricultural development, spread agricultural knowledge and generally improve the methods and results of agriculturists.

This Department consists of administrative and research branches at headquarters and divisional agricultural and pest control organizations. Other departments of Government deal with other subjects related to agriculture, *e.g.*, irrigation projects are investigated and constructed by the Irrigation Department, the

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This Memorandum and the two following were prepared for the Imperial Agricultura Research Conference held in 1927

meteorological observatory forms part of the Survey Department, and veterinary matters are dealt with by the Veterinary Department. Separate industries have been encouraged also to provide for research for themselves and in 1926 a Tea Research Institute was established by the tea industry. For some 14 years a special Research Scheme, formed by the co-operation of the Ceylon Government, with the Rubber Growers' Association and rubber estates in Ceylon, has been working on problems of the rubber industry.

A.—Department of Agriculture.

The Department has in recent years set itself to the task of assisting the prevention of soil erosion in hilly sections, the development of a permanent system of cultivation to replace the existing shifting cultivation of jungle areas, the development of cotton and tobacco growing in definite areas, the improvement of paddy cultivation and, the control of pests and diseases in addition to specific researches by its various specialist divisions.

F. A. Stockdale, C.B.E., M.A., F.L.S., Director.

(a) **Mycological Division.**—This division examines generally and reports upon all cases of plant disease of fungus origin of economic (and other) plants. It conducts special research work and at the present time has in hand certain definite investigations relating to diseases of the main economic crops; the investigation of the distribution, conditions of occurrence, and biology of root disease fungi in general and *Rhizoctonia bataticola* in particular, coconut root diseases, bunchy top disease of plantains, the diseases of paddy and the biology of *Diplodia*.

Of the problems in hand that of *Rhizoctonia bataticola* is perhaps the most important, for it seems to shed entirely new light on the causation of root disease in the tropics. It has given rise, in fact, to a new view which must be tested by the experience of as many regions as possible throughout the tropics.

Staff: W. Small, M.B.E., M.A., B.Sc., Ph.D., F.L.S., Mycologist.

M. Park, A.R.C.S., Asst. Mycologist.

J. C. Haigh, A.R.C.S., B.Sc., Asst. Mycologist.

(b) **Entomological Division.**—This division is concerned mainly with the investigation of the various insect pests of the different economic crops of the Island. In recent years special investigations have been made into the shot-hole borer pest of tea, tea tortrix and other pests of tea. Arrangements have been made for most of the investigations of tea pests to be handed over to the Tea Research Institute, but work on the tea termites

(*Calotermes* sp.)—one of the most important present-day problems of the tea industry in Ceylon—and on scale insects (*Coccus viridis* and *Saissetia hemispherica*) is being continued by this division. Special attention has been given to the insect pests of green manures and shade trees and to various pests of important vegetable and food crops *Epilachna* and *Aulacophora* beetle pests of cucurbits, the bean fly (*Agromyza*) and pests of plantains are at present receiving special attention. The control of *Opuntia dilenii* by means of *Dactylopius tomentosus* has recently been undertaken and is progressing successfully. Plans for the development of sericulture (the Eri silk-worm) are being made and preliminary experiments with some insecticides are being carried on.

Staff: J. C. Hutson, B.A., Ph.D., Entomologist.
F. P. Jepson, M.A., F.E.S., Dip. Agric. (Wye.), Asst. Entomologist.

(c) **Chemical Division.**—This division has only recently been organized and the chief problems that have been or are in hand are as follows:—

(1) The decomposition of green and organic manures under Peradeniya conditions.

The work so far done on this subject has included

(a) Systematic analyses of the more widely used leguminous and non-leguminous green manures in Ceylon.

(b) Laboratory and field experiments on the nitrification of green manures. The green manures forked into the plots were in the first series of field experiments grown elsewhere.

A second series of field experiments have now been started to study the rates of nitrification of green manures when the crops forked into the soil are grown *in situ*.

(2) Nitrogen-fixation in Ceylon soils generally.

(3) The leaching of fertilizers from Ceylon soils.

The results of preliminary laboratory experiments on this subject have already been published. A more elaborate series of pot experiments are now being carried out to ascertain the amounts of soluble fertilizer leached from Ceylon soils under Peradeniya climatic conditions when (a) a crop is grown, (b) no crop is grown in the pots.

(4) The mineral analyses of a large number of Ceylon's cultivated and uncultivated fodder grasses have been carried out.

Staff: A. W. R. Joachim, B.Sc., A.I.C., Dip. Agric. (Cantab), Agricultural Chemist.

(d) **Division of Economic Botany.**—The work of this division is at present as follows:—

(1) Selection of pure line strains of rice, their testing and distribution to Divisional Officers.

(2) Pure line selection of *Eleusine coracana* and other fine grains.

(3) Pure line selection of certain vegetables, *e.g.*
Hibiscus esculentus.
Vigna sinensis

(4) Cultural and manurial experiments with rice: general work on rice agronomy.

(5) Research on the technique of testing rice selections.

(6) And, when time permits, a classification of the Ceylon rices.

This division was started primarily to effect an improvement in the paddy industry and has up to the present time produced a number of pure-line paddies which are now in the process of testing upon 19 different stations in various parts of the Island.

Staff: L. Lord, M.A., (Oxon)., Economic Botanist.

(e) **Division of Systematic Botany.**—This division deals with identifications of Ceylon plants and has in hand at the present time research work on certain groups, the preparation of a supplementary volume to the Flora of Ceylon and the preparation of a Students handbook of a part of the flora.

Staff: A. H. G. Alston, B.A., Systematic Botanist.

(f) **Central Experiment Station.**—This is the main experiment station of the Department and various researches in general agriculture are being carried on. The main crops are tea, rubber, cacao, coffee, paddy, fodder grasses, green manures and cover crops, fruit. Cattle breeding is also being commenced. The experimental work comprises the measurement of actual amounts of soil erosion taking place and the trial of ameliorative measures, cover crops, etc. Manurial experiments with tea, rubber, coffee, cacao, etc. Cover crop experiments in tea and rubber, varietal tests with coffee, coconuts, tapping experiments with rubber, the vegetative propagation of Hevea and the correlation between various vegetative characteristics.

Staff: T. H. Holland, Dip. Agric. (Wye.), Manager.

(g) **Plant Pest and Disease Inspection.**—This division is charged with the prevention of the importation of pests and diseases at ports of entry and with the control measures against weeds and pests and diseases of the principal economic crops. It is responsible for field investigations of different pests and diseases and has recently been engaged upon a campaign of eradication directed against the water hyacinth.

Staff: *Inspectors*: Central—N. K. Jardine, F.E.S., B.Sc.
North-Western—C. N. E. J. De Mel, B.Sc. (Agric.).
Southern—W. C. Lester Smith, B.A. (Oxon).

Inspector in charge of Fumigatorium at Colombo and working under the general supervision of the Entomologist.

F. D. Peries.

(h) **Agricultural Divisional Organization.**—The divisional agricultural officers are responsible for the control of experiment stations, testing and distribution of improved varieties of crops (especially paddy), general agricultural investigations and the development in their respective divisions of special industries, agricultural education and co-operation. The extension and propaganda work of the Department is carried on through the divisional organization and special investigations on paddy, cotton, tobacco and crop rotations are being carried on. The island has been divided into six divisions but at the present only four have been organized.

Staff: G. Harbord, Dip. Agric. (Wye.),
F. Burnett, M.A. (Oxon).
G. E. J. Hulugalle, Dip. Agric. (Cantab).
W. P. A. Cooke, M.Sc. (Calif.).

(i) **Botanic Gardens.**—The Botanic Gardens in Ceylon consist of the Royal Botanic Gardens, Peradeniya, established in 1822, the Botanic Gardens, Hakgala, established in 1860, and the Heneratgoda Gardens opened in 1876. These gardens continue introductions and acclimatization of plants of botanical and economic importance. Special attention has been given recently to those trees which yield Chaulmoogra oils required for the treatment of leprosy, to further trials with improved types of cinchona and to the vegetative propagation in the various nurseries of the gardens of improved strains of tropical and sub-tropical fruits. It is expected that this last mentioned work will assume much larger proportions within the next few years.

Staff: T. H. Parsons, F.R.H.S., Curator,
Royal Botanic Gardens, Peradeniya.
J. J. Nock, Curator, Botanic Gardens, Hakgala.
K. J. Alex Silva, F.R.H.S., Asst. Curator,
Heneratgoda Botanic Gardens.

(j) **Co-operative Division.**—This is charged with the development of co-operative organizations for credit and for the purchase of supplies and for the sale of produce.

Staff: F. A. Stockdale, C.B.E., M.A., F.L.S.,
Registrar.
W. K. H. Campbell, B.A. (Oxon), C.C.S.,
Joint-Registrar.

B.—Rubber Research Scheme.

This scheme is managed by an Executive Committee in Ceylon of which the Director of Agriculture is Chairman with

the advice of a special Committee in London. Technical Committees have also been formed both in Ceylon and in London. The scheme is responsible for definite technical researches into the rubber tree and its products. Investigations into crop improvement, the physiology of the rubber tree, the chemistry of latex and of rubber, the diseases of rubber are being made in Ceylon and into the vulcanizing, ageing and other properties of raw rubber from Ceylon by a special staff in London.

Staff: (Ceylon).
J. Mitchell, A.R.C.S., Organizing Secretary.
T. E. H. O'Brien, B.Sc., A.I.C., Chemist.
R. A. Taylor, B.Sc., Physiological Botanist.
Vacant Mycologist.
(London).
G. Martin, B.Sc., A.I.C., Chemist.
W. S. Davey, B.Sc., A.I.C., Chemist.
F. L. Elliott, F.I.C., Chemist.

C.—Tea Research Institute.

This separate organization has recently been formed by the tea industry through a cess on exports collected by Government at the Customs.

Its present staff consists of:—
T. Petch, B.A., B.Sc., Director.
C. H. Gadd, D.Sc., Mycologist.
S. Stuart Light, B.Sc., Entomologist.
D. I. Evans, B.Sc., Biochemist.

Endeavours are now being made to secure a Soil Chemist.

D.—Meteorological Observatory.

This forms part of the Survey Department and issues reports on its various meteorological investigations and researches.

Staff: A. J. Bamford, M.A., B.Sc., F.R.A.S., F.R.C.S., F.R.Met.S., Superintendent.
H. Jameson, B.Sc., Assistant Astronomer.

E.—Veterinary Department.

This Department is charged with the investigation of diseases of animals in the Colony and with the control of any outbreaks which may occur. It also has charge of the Government dairy at Colombo and has carried out various researches into animal disease. At present it is engaged upon investigations into the nutrition of animals and the results of deficiencies of certain mineral constituents in fodders and feeding stuffs.

Staff: G. W. Sturgess, M.R.C.V.S., Government Veterinary Surgeon.
M. Crawford, M.R.C.V.S., Asst. Government Veterinary Surgeon.

Memorandum on Agricultural Research Work in Hand at Present in Ceylon.

F. A. STOCKDALE, C.B.E., M.A., F.L.S.,
Director of Agriculture.

The Department of Agriculture.

THIS Department is supported wholly from Public Funds. Its Revenue is approximately £7,000 annually and its expenditure in 1926 was £54,685 which is conveniently separated into the following main heads:—

Administration	...	£3,238
Research: Scientific investigations, including Central Experiment Station	...	£18,892
Botanic Gardens: including Gardens of Governor's and Colonial Secretary's residences	...	£6,057
Agricultural Education: including School of Tropical Agriculture, Farm School, Jaffna, School Gardens, grants to shows and competitions	...	£3,838
Divisional Experiments: including experimental cultivation of Cotton and Experiment Stations in Jaffna and Anuradhapura, and other experimental plots	...	£19,737
Co-operative Societies	...	£1,078
Seed Store and Publication Depot	...	£1,845

Its Officers are pensionable Government officers.

Its Research branches, as distinguished from the (1) administrative, (2) the divisional agricultural organizations for the assistance of small cultivators and for the study and development of new crops, and (3) the plant pest control organization, consist of the Mycological, Entomological, Chemical, Economic Botany divisions and the Central Experiment Station. Certain problems involving research—mainly agricultural—are also undertaken by the Divisional Agricultural Officers on their several experiment stations and crop improvements are being effected through the co-operation of these officers and the Economic Botanist's division.

The following details indicate briefly the work at present in hand:—

Mycological Division.—Investigations relating to the diseases of the Colony's main economic crops. *e.g.*, tea, rubber, coconuts, cacao, paddy, citronella, arecanuts, tobacco and grain crops. Special investigations are being made at present into the distribution, conditions of occurrence and biology of root diseases in general, of coconut root diseases, the bunchy top disease of plantains (bananas) and into the diseases of paddy. The widespread occurrence of *Rhizoctonia bataticola* has recently been observed by the Mycologist and sufficient field evidence has been secured to warrant the belief that this fungus is probably the cause of much of the root diseases of plants in the Colony. Special laboratory investigations have been begun and infection experiments started. The parasitism of the fungus is being put to a thorough test, as its occurrence has been found in all the finer rootlets of plants affected with root disease. This problem of *Rhizoctonia bataticola* is the most important mycological investigation in hand at present and considerable concentration is being devoted to the various aspects of the problem, as it seems to shed an entirely new light on the causation of root disease in the tropics and it has given rise to a new view which should be tested in as many regions as possible throughout the tropics. The biology of *Diplodia* is also being studied and a full series of inoculations on rubber, tea, cacao and citrus plants have been begun.

Entomological Division.—The investigations into the shothole borer of tea have recently been completed and various control measures tried out experimentally. Tea Tortrix has also been investigated and further work on this pest has now been handed over to the Tea Research Institute. The Entomological division of the Department of Agriculture is concentrating at present on the termites affecting tea—one of the most important present-day problems of the tea industry of Ceylon, and on two scale insects (*Coccus viridis* and *Saissetia hemispherica*) which do considerable damage in one district. Special investigations are also being made into the insect pests of green manures and shade trees, and into various pests of important vegetable and food crops. The *Epilachna* and *Aulacophora* beetle pests of cucurbits, the bean fly (*Agromyza*) and pests of plantains are at present receiving attention and the resistance of various types of beans to *Agromyza* attack is being tested. Investigations are also being made into the pests attacking paddy. The control of *Opuntia dilenii* by means of *Dactylopius tomentosus* has recently been most successful. Plans are also in hand for the development of sericulture (the Eri Silk-worm) on castor.

Chemical Division.—The following problems are being investigated:—

(1) The decomposition of green and organic manures under conditions prevailing at Peradeniya.

(2) Nitrogen fixation in Ceylon soils.

(3) The leaching of fertilizers from Ceylon soils under the climatic conditions prevailing at Peradeniya.

(4) The analysis for mineral constituents of Ceylon's cultivated and uncultivated fodder grasses.

(5) Analyses of various types of citronella grasses preparatory to work by the Divisional Agricultural Officer, Southern, on selection.

Economic Botany Division.—(1) The selection of pure-line strains of paddy (rice), their testing and distribution to Divisional Officers.

(2) Pure-line selection of kurakkan (*Eleusine coracana*) and a few other fine grains.

(3) Pure-line selection of certain vegetables, *e.g.*, *Hibiscus esculentus*, *Vigna sinensis*.

(4) Cultural and manurial experiments with paddy (rice) and general research into the technique of the field testing of paddy (rice) selections.

Central Experiment Station.—This is the main experiment station of the Department and researches in general tropical agriculture are being here carried on. The experimental work comprises the measurements under controlled conditions of the actual amounts of soil erosion taking place together with the trial of ameliorative measures, cover crops, etc. Cultural and manurial experiments with tea, rubber, coffee, cacao, paddy, etc., are being conducted. Tapping experiments with rubber are being carried out and a study of the correlation of characters of *Hevea brasiliensis*, in plots of known parentage on the female side, has been the subject of careful statistical investigation in collaboration with other officers of the Department and with the Rubber Research Scheme. Cover crop experiments in tea and rubber, the trial of green manures, varietal tests with coffee and coconuts and the vegetative propagation of rubber and the isolation of selected types are also in hand. Dynamometer tests with various ploughs including the various types of indigenous ploughs used in paddy cultivation have recently been begun.

The Rubber Research Scheme.

This scheme was started in 1913 when a certain number of rubber estate companies undertook to co-operate with the Government of Ceylon for investigations into the chemistry and physiology of *Hevea brasiliensis* in Ceylon and into the vulcanizing, ageing and other properties of raw rubber at the Imperial

Institute, London. The officers in Ceylon were attached to the Department of Agriculture and those in London to the Imperial Institute. Contributions were purely voluntary and the Government of Ceylon undertook to contribute to the expenses of the investigations on the basis of 60% of the total annual expenditure. At the same time the Rubber Growers' Association employed in Ceylon for those rubber estates contributing to the Association a chemist and a mycologist. In 1920, a re-organization of the Ceylon Rubber Research Scheme took place and its scope was considerably extended. The Government of Ceylon agreed to contribute to the expenditure on the same basis of 60% of the total annual expenditure up to a limit of £4,500, the Rubber Growers' Association guaranteed £2,000 annually and estates in Ceylon which were not contributing to the Rubber Growers' Association agreed to contribute to the Scheme at a subscription rate equivalent to that payable by the Rubber Growers' Association. Such subscriptions were voluntary but the number of subscribers has been increasing annually until at the end of 1926 there were 102 Rubber Growers' Association Members and 109 Ceylon members, making a total of 211 members in all representative of nearly 65% of the total rubber acreage in bearing in Ceylon. The estimated income of the Scheme for 1927 is £9,280 and its estimated expenditure £10,300, including £1,500 from reserves to be expended on the development of a special experiment station of budded rubber for the purpose of selecting, testing and isolating high yielding types.

The Government contribution is paid as a grant-in-aid (votable annually by the Legislative Council) and the Scheme is managed by an Executive Committee in Ceylon of representatives of the the rubber industry under the Chairmanship of the Director of Agriculture. An advisory committee has been constituted in London and includes representatives of the Rubber Growers' Association, Ceylon Planting Interests, Rubber Manufacturers, British Rubber and Tyre Manufacturers, Research Association and the Imperial Institute. Technical Committees have also been formed both in Ceylon and in London. The Scheme is responsible for definite technical research work in connection with the rubber tree, its latex and its raw products.

Its officers are not pensionable Government officers but are paid salaries equivalent to those paid to the staff officers of the Department of Agriculture and receive bonuses at the rate of 20% of their salaries payable at the termination of 4 or 5 year agreements in lieu of pension rights. They are under the general control of the Director of Agriculture.

The work in hand at present comprises the following:—

Chemist.—1. The effect of different dilutions of latex when Formic Acid and Sodium Silicofluoride are used as coagulants.

2. Experiments on the utilization of waste serum.

3. To determine the effect of the mineral content (such as iron) of factory water on the quality of rubber produced.

4. Experiments with a view to improving plasticity.

5. Experiments on the elimination of smoking.

6. Packing of Rubber (Smoked Sheet).

7. To determine the effect of rolling on the drying of sheet and crepe rubber and on the quality of the rubber.

8. Experiments with a view to improving ageing properties of rubber when vulcanized in a rubber sulphur mixing.

9. To study the economics of factory work with a view to standardisation of the methods employed, machines in use, etc. Also to enquire into the question of smoke houses and the smoking of rubber as carried out on estates.

10. To study the effect of manuring of rubber, the most suitable mixture to apply, the best methods of application and the quantity to apply under the varying conditions of rainfall and soils in Ceylon. Also the effect of manuring on diseases.

Physiological Botanist.

1. Investigation of Brown Bast.

2. Selection of high yielding types and testing of same in the field. Vegetative propagation.

3. Study of characters of high yielding trees and correlation of such characters.

4. Study of the contour system of planting for the prevention of soil erosion and of various cover crops.

5. Study of the change-over system of tapping.

6. Manurial experiments with rubber.

Mycologist.

1. Further investigations of bark diseases and of the use of disinfectants on tapping cuts.

2. Further study of pod-disease and leaf fall and of the practicability under Ceylon conditions of spraying.

The programme of work in London for 1927 is as follows:—

1. The extent and causes of variability of Ceylon plantation rubber in respect of (a) plasticity, (b) time of vulcanization and mechanical properties in different mixings, (c) ageing.

2. Developments in the rubber industry of direct interest to the planter, *e.g.*, (a) Sprayed Rubber, (b) Revertex.

3. Possible differences between Fine Hard Para and plantation rubber which may account for the preference of manufacturers for the former for the manufacture of such articles as golf ball tape, elastic thread.

4. The effect of the non-caoutchouc constituents of latex on the ageing of the raw and vulcanized product.

5. The use of latex serum products.

6. The behaviour of different samples of plantation rubber when successively exposed to temperatures about 0 C and 20 C.

Examination will also be made of samples prepared in connection with investigations in progress in Ceylon, *e.g.*, (a) The use of paranitrophenol, (b) Spraying of trees with fungicides, (c) Methods of smoking and drying.

Tea Research Institute.

This institute was constituted by Ordinance No. 12 of 1925. It secures its funds by a cess of one-tenth of a cent. per pound on all exports of tea from Ceylon and its estimated revenue is £14,000 per annum. It is at present located in temporary quarters but negotiations are now in hand for the purchase of a tea estate for experimental work and for the location of its laboratories and factory. The institute is managed by a Board of Management of ten members representative of the various interests connected with the tea industry in Ceylon together with the Director of Agriculture and the Colonial Treasurer as Government representatives. Its officers are not pensionable Government officers and are engaged by the institute on special agreements. The institute has only recently been organized and its staff has only just been secured. Its present programme of work—drawn up in consultation with the Department of Agriculture to prevent overlapping is as follows:—

Biochemist.—The Biochemist should begin his investigations of the manufacture of tea by a study of the Chemistry of the Tea Leaf, whereby he can test out methods of analysis and select standard methods for adoption in all subsequent work. Investigation of Hydrogen ion concentration of soils in relation to yield and quality.

Soil Chemist.—Investigation of the decomposition of manures, nitrification, losses by leaching, etc., co-operative manurial experiments and experiments on soil erosion which can be carried out under the immediate control of the Institute's Chemist.

Mycologist.—Investigation of the Cercosporella leaf disease and its relation to Acacias and other green manure plants.

Investigation of the Diplodia root disease, especially as regards the curative action of lime. Determination of the reaction of the fungus to "acidity" of the soil, and the action of lime on the fungus and the cell sap of the bush. Investigation of diseases of tea seedlings. Hydrogen ion concentration of soils in relation to disease.

Determination of the micro-organisms present on the flush at different seasons before and after withering.

Investigation of the Ambrosia fungus of the Shot-hole Borer beetle and the determination of the relations between the fungus and the bush, with a view to a possible method of control of the beetle.

Entomologist.—Investigation of Scarlet Mite (the "Red Rust" of the Haputale District), Tea Tortrix, Nettle Grub.

The Department of Agriculture will continue the following investigations.

1. Further investigations into Tea Termites and measures for their control.

2. Further study of the control measures against "Brown Bug" and "Green Bug."

3. Wood Rot.

4. Root diseases caused by or associated with *Sclerotium Bataticola*.

5. General chemical investigations on the leaching of manures and on the decomposition of organic and green manures under Peradeniya conditions.

6. Soil erosion experiments on Peradeniya Experiment Station.

Summary.

In brief, the work in Ceylon may be summarized under the headings specified by the Secretary of State for the Colonies as follows:—

(1) **Soil Surveys.**—These are not being undertaken. A preliminary investigation of Ceylon tea soils was made several years ago by Bamber and has been continued in recent years by Bruce and Keiller—all private analysts. A preliminary survey of Ceylon Forest Soils and of Paddy (Rice) Soils has also been made by Bruce and published as Bulletins by the Department of Agriculture. The chemical staff in Ceylon is not sufficiently strong to contemplate a serious soil survey at present.

(2) **The Effects of Irrigation on Soil Fertility.**—Irrigation in Ceylon is confined to Paddy (Rice) cultivation and to tobacco and garden crops in areas deficient in rainfall during the south-west monsoon season. Only one preliminary investigation has been begun on the effect of irrigation on soil fertility. This was begun in connection with experiments in regard to the cultivation of a dry crop of tobacco in an area where this crop is usually irrigated. It has been found that better dry crops of tobacco are raised without irrigation if they are grown on land which has

never been irrigated rather than on lands usually irrigated. Investigations so far made indicate that the physical condition of the soil is changed by irrigation. It is also known in Ceylon that in certain areas paddy (rice) fields under irrigation gradually lose their initial fertility but the cause of this has not yet been investigated.

(3) **Soil erosion, surface protection and green manuring of crops.**—The Sinhalese in Ceylon in the early days, as in most countries in the East, carefully terraced their hill slopes which were required for paddy (rice) cultivation. This was done in order to provide for flat areas which could be satisfactorily flooded for the growing of the paddy crop. In the early days of permanent cultivations on estates adequate attention was not given to the question of soil erosion from hill slopes. Much valuable top soil was lost, rivers and streams were silted up and the general fertility of the land reduced. The first attempts to prevent such erosion consisted in the provision of contour drains. Gradually the number of such drains was increased, their slopes decreased and in recent years the provision of an adequate number of silt pits either in conjunction with the drains or independent of them has been made. In rubber cultivation, the provision of low stone walls were built on the contours and in many situations the terracing with stone walls of individual trees was resorted to with advantage. In the opening of new lands, the planting of contour hedges of leguminous plants was occasionally practised. In 1923 the Department of Agriculture not being satisfied that sufficient was being done to prevent soil erosion launched a campaign dealing with the question. As a result much has been accomplished in recent years. In the opening of new lands various forms of terracing have been experimented with and the system of contour platform terracing combined with the growing of leguminous cover crops is now commonly adopted in the opening of new areas. The provision of silt pits throughout older areas of tea and rubber has become general, contour walls of stone are being continually built and contour planting of leguminous plants in the form of hedges is increasing. The results of these works are being closely watched by the Department, which is freely consulted on questions affecting soil erosion and the growing of green manure crops. A carefully planned experiment has been inaugurated on the Experiment Station, Peradeniya, to test the amount of soil erosion which is taking place and the effect of certain ameliorative measures. These experiments have been designed to represent existing tea cultivation in Ceylon and the first year's measures showed that ·17 acre-inches of top soil had been lost. Further figures will, however, shortly be available. The growth of green manure crops is becoming much more general. The use of tree forms such as *Albizzia moluccana*,

Erythrina lithosperma, *Acacia decurrens*, *Gliricidia maculata*, (which were lopped at different intervals) is spreading, and at present these are grown systematically throughout the greater portion of the tea cultivations of Ceylon. In the drier areas *Grevillea robusta* is largely grown. This is not lopped but provides a large leaf fall annually. The choice of plant depends upon the situation and elevation of the plantation. The systematic replacement of these plants has been the subject of some study and the question of the desirability of the rotation of these green manures has been raised. Experiments conducted on the Experiment Station, Peradeniya, have demonstrated the beneficial effects on tea of growing *Erythrina lithosperma* and *Albizzia moluccana*—the plots in which these have been grown having consistently yielded heavier crops than those receiving artificial manures. Trials are also being made with other recently introduced tree forms such as *Albizzia stipulata*, *Derris robusta* and *Acacia lopantha*. In tea also the growing of bushy forms of green manures such as *Tephrosia candida* and *Crotolaria usarimoides* has been beneficial in several areas and experimental work is now being conducted on the Experiment Station, Peradeniya, and upon several estates with the growing in old tea of a creeping cover crop such as *Indigofera endecaphylla*. The effect of such a cover crop on the tea yields and the correct agricultural methods of dealing with it are under investigation. In old rubber, considerable progress has been made with the establishment of *Vigna oligosperma*—a creeping cover plant which is shade-loving. In young rubber, the use of species of *Crotolaria*, *Tephrosia* and *Desmodium* is general, whilst amongst creeping plants *Centrosema pubescens*, *Pycnospora hedysaroides* and *Calopogonium mucunoides* are employed and investigations into the suitability of certain creeping indigenous leguminous plants have been begun. In coconuts the use of *Tephrosia candida* is common. On slopes this is grown in hedges and on the flat where ploughing of coconuts is carried out in between alternate rows. It is lopped regularly and the loppings buried. In certain areas, on slopes the construction of large contour drains has become common and these assist in the prevention of soil erosion and also assist in the conservation of water in the soil—a matter of some importance in areas liable to heavy rains at certain periods of the year and to extremely dry weather at others. In paddy cultivation green manuring is spreading. In the north and in certain other areas the use of *Crotolaria juncea* as a green manure crop in rotation with paddy is common and is spreading as the result of propaganda work by the Divisional Agricultural Officers. Green leaf manuring is now generally practised in the Kandy District of the Central Province and is increasing in other districts, whilst the use in recent years of *Gliricidia maculata* in

the Kurunegala District for fencing around paddy-fields has resulted in the frequent use of its leaves in paddy cultivation in that area. For certain crops, such as betel, vegetable cultivation, tobacco cultivation, chilli growing, etc., green-leaf manuring has been common for long periods and the selection of the leaves of certains specific plants for particular crops is a common practice. Analytical work in connection with green manure crops is in hand in the Chemical division and definite investigations into the decomposition of green manures under conditions prevailing at Peradeniya are being continued.

(4) **Plant Breeding and Seed Selection.**—(a) The selection of high yielding strains of rubber and the study of correlated characters are being carried out by the Central Experiment Station at Peradeniya and by the Rubber Research Scheme.

(b) The selection of pure-line strains of paddy (rice) is being carried out by the Economic Botanist on two main stations and in co-operation with Divisional Agricultural Officers at 19 sub-stations.

(c) Pure-line selections of kurakkan (*Eleusine coracana*) and of certain vegetables are also being undertaken by the Economic Botanist.

(d) Selections in chillies, kurakkan and Italian millet (*Setaria Italica*) are being made at the Jaffna Experiment Station by the Divisional Agricultural Officer, Northern.

(e) Mass selection in cotton to provide selected seed for the cotton growing area in the Hambantota District is being made by the Divisional Agricultural Officer, Southern.

(5) **Methods adopted for the Publication of the Results of Researches.**—Research work in progress is reported upon and discussed at the regular meetings of the various Committees of the Board of Agriculture and at the Annual Agricultural Conference. These statements secure publication in the local press and in the *Tropical Agriculturist*, the Agricultural Journal of Ceylon. Special articles are also written for publication in the *Tropical Agriculturist* the issue of which is now 1700 monthly. The Department of Agriculture has issued annually since 1923 a Year-Book which embodies in brief the principal technical work undertaken by the officers during the previous year. This Year-Book is distributed gratis to all members of the Executive and Legislative Councils and of the principal agricultural bodies, *e.g.*, Board of Agriculture, Estates Proprietary Association, Ceylon Planters' Association, Low-country Products Association. Copies are also provided to the Public Libraries, Libraries of Secondary Schools and to the principal clubs. Exchange copies are also sent abroad to the various Colonial Departments of Agriculture and to the Ceylon Association in London. Completed research

work is published in the form of Bulletins and special papers embodying matters of more academic than practical interest are either published in the Annals of the Royal Botanic Gardens which forms now Section A. of the Ceylon Journal of Science or are contributed to appropriate scientific journals in the United Kingdom. The Rubber Research Scheme issues Circulars quarterly which are incorporated from 1927 in the *Tropical Agriculturist* and Bulletins (forty-six up to date) embodying the detailed research work of its officers. These Bulletins have in the past been issued only to subscribers to the Scheme and as exchanges with other Research Institutes, but from 1927 it has been decided to make these Bulletins available generally for an annual subscription of £1.

The Tea Research Institute also proposes to issue Bulletins. None has been issued up to date.

Memorandum on Work of the Veterinary Department, Ceylon.

G. W. STURGESS, M.R.C.V.S.,
Government Veterinary Surgeon.

THE Veterinary work is carried out by the staff of the Veterinary Department, consisting of two European Veterinary Sugeons, 12 Graduates of the Indian Veterinary Colleges, and 15 Stock Inspectors—all paid from public funds. There are no associations engaged in veterinary research work.

2. The work is chiefly confined to prevention and suppression of infectious diseases as Rinderpest, Foot and Mouth Disease, Trypanosomiasis, Piroplasmosis, Anthrax and Rabies.

Considerable work is done with reference to the quarantine of cattle, sheep and goats from Asiatic and African ports to Colombo, chiefly for purposes of slaughter, and mainly from India. 9804 cattle and buffalos and 110,957 sheep and goats were imported during 1926. A large quarantine station is in charge of the Colombo Municipal Council.

3. Research work includes investigation as to the cause of osteitis fibrosa (Osteoporosis) a disease, very common amongst imported horses (English, Australian and Arab)—and its connection with mineral deficiencies in the foods, which is believed to be the chief factor.

Another point under consideration is the deficiency of mineral elements in the natural pastures, and its effect on the growth and development of the live-stock. It is considered that there is a deficiency, chiefly of Calcium, all over the Island, and influence has been brought to bear on the importation of sterilised bone flour, and the general question of administration of lime in some form to live stock.

A considerable variety of agents have been tested for effect on the 4th stomach worm (*Mechstocirrus digitatus*) of cattle, which causes much loss.

The department also supervises the Government Dairy, which supplies the large hospitals with milk, and at the same time conducts investigation with reference to the crossing of Indian cattle (Zebus) with the European breeds. At present imported Ayrshire bulls are being tried with very promising results.

4. Results of the working each year are summarised and published in the Annual Administration Report.

Special Memoranda.

Memorandum I.

The Establishment of a Bureau of Soil and Agricultural Chemistry.

From the Department of Agriculture.

FOR some years, I have felt the need in the various Tropical Colonies in which I have seen service of a Bureau of Soil and Agricultural Chemistry on the lines of the Imperial Bureaux of Mycology and Entomology. This need is felt by the Department of Agriculture in Ceylon at the present time to be urgent and of importance. Most Agricultural Departments in the Tropics began from the amalgamation of the Botanic Gardens Departments with those of the so-called Government laboratories. The Chemists which were appointed in the early eighties rendered valuable services to their respective colonies, but in later years the necessity for the study and control of pests and diseases overshadowed the importance of soil investigations and even more recently the results which could be secured in crop improvements have tended further to place soil investigation in a more unsatisfactory position. What additional drain upon our soils these increasing crops are making is not being sufficiently studied nor steps taken to meet this drain upon soil fertility. In Ceylon crops are being maintained by increasing importations of artificial manures, but the importance of the question of soil erosion and of maintenance of humus content has only recently been realised and the importance of utilising green manures even in permanent crops recognised. The Department of Agriculture in Ceylon added and equipped a chemical division to its branches only in 1925, but it is becoming more and more evident that pests and diseases—to which Ceylon has throughout given special attention—can only be tackled under tropical conditions by agricultural methods. Hutson, at the Agricultural Conference held at Peradeniya in 1925, dealt with this aspect of tropical Entomology and it has also been previously dealt with by Ballou in the West Indies and by workers attached to the Sugar Experiment Stations in Java. A much closer investigation, along modern lines, of our Empire's tropical soils and of the effects

of the various cultural methods in vogue are necessary. Much valuable work has been done in India and work in Ceylon on the decomposition of green and organic manures, on the nitrification of green manures, on the nitrogen fixation in Ceylon soils and in the leaching of fertilisers from soils has been begun. Co-ordination of the work throughout the tropics is essential, guidance from authoritative workers in the United Kingdom is often necessary and a recognised review of the research work with soils being conducted throughout the Empire is necessary if progress is to be maintained. The obvious centre for such a Bureau is the Rothamsted Experiment Station—the recognised centre in the world for knowledge concerning the chemistry and physics of soils. In the tropical colonies, our experience with the various soils and crops is frequently of a comparatively short duration. Such soils are the essential primary asset of the cultivators. They are subject to conditions of rainfall and of climate which are greatly different to those of temperate climates, and demand the closest investigation if irreparable damage is to be avoided. Many Ceylon soils which have been cultivated under successive crops are at present abandoned. They have been eroded and leached and rendered comparatively barren. Such lessons should be of value to other parts of the tropical portions of the Empire which have been developed more recently than Ceylon, and it is on this account that the establishment of a Bureau of Soil and Agricultural Chemistry is brought forward.

Memorandum II.

The Co-ordination of General Agriculture and Agronomy in the Tropics.

From the Department of Agriculture.

Whilst the specialist branches of Departments of Agriculure in the Tropics have their Bureaux of Mycology and Entomology it must not be overlooked that general agricultural knowledge and agronomy form a very important function of all Departments of Agriculture in the Tropical Colonies and Protectorates. A close study of indigenous methods of agriculture and of existing agricultural practices is essential before improvements can be experimented with and suggested. Officers who have had the advantage of service in various colonies recognise the value of the study of various agricultural practices under slightly varying conditions,

and estates in the East derive considerable advantage from senior superintendents visiting neighbouring countries. Visits between Ceylon, Malaya and Dutch East Indies are frequent and are recognized as being of material benefit.

Agricultural officers perform their best services to any country after some years of experience therein, and constant changes from colony to colony would not be on the whole advantageous. It is therefore suggested that measures should be taken either through the Ministry of Agriculture or through the Royal Botanic Gardens for the dissemination of knowledge throughout the tropical colonies and protectorates of various agricultural practices. Knowledge of the results of trials of recently introduced crops in one colony may often be of value to another. Experience has shown that experiments with certain cultural methods have often given results, which have previously been secured in another colony and which were unknown when the initial experiments were outlined. Time could have been saved if this knowledge was generally available and only too often is highly important experimental work dismissed in a brief paragraph of an Administration Report. Similarly the experience of the various units of the Empire in the laying out of field experiments with various crops and with the interpretation of results should be co-ordinated. Methods of field experimentation with annual crops are becoming more and more standardized, but increasing experience with such permanent crops as cacao, tea, coffee, rubber and coconuts only confirms the difficulties in dealing experimentally in the field with permanent tropical crops. Much assistance could be rendered to the workers in the tropics and much time saved if the experience of workers in the different colonies and protectorates could be made available through a central Clearing-house.

Memorandum III.

Provision for Specialists to Visit Other Colonies and Protectorates.

From the Department of Agriculture.

The need is often felt by research officers of Agricultural Departments in the Tropics for visits to other Colonies and Protectorates. Such visits, even if only of a short duration, would be of the greatest value when specialists were working on a common problem. Entomological problems, involving the study of parasites, often demand such visits to other countries, but the importance of what may be after all

only a fruitless research is sometimes difficult to recognise. Modern Mycological research shows more and more plainly how wide-spread certain fungi are and the interchange of visits between mycological officers might, if they could be arranged, save a considerable amount of duplication of labour. Recent mycological work in Ceylon has indicated the wide-spread occurrence of the fungus *Rhizoctonia bataticola* in connection with root diseases of economic and other crops. There is difficulty at times in finding the fungus and reports from any given region to the effect that the fungus is not present cannot always be accepted as final. It would be of value to Ceylon to know whether this particular fungus is also of wide-spread occurrence in South India, Malaya and the Dutch East Indies and a visit to these countries by the Ceylon Mycologist would not only be of value to Ceylon but also to tropical agriculture in general. Other instances could be quoted, but the importance to Mauritius of the visit of the Director of the Imperial Bureau of Entomology to the West Indian Agricultural Conference of 1912 need only be mentioned to make the position clear. Individual Colonies are hardly likely to approve of expenditure of funds for services of a general rather than a particular character and the Conference is therefore invited to consider whether special funds could be set aside by the Empire Marketing Board or other organization for such visits of specialists as have been outlined above.

Memorandum IV.

The Effect of Grasses and Other Plants (e.g., Leguminous Cover Crops) on Permanent Tropical Crops.

From the Department of Agriculture.

A very large number of tropical crops are of a permanent character, and whereas some Colonies are strongly attached to the clean-weeding method of cultivation, others—sometimes by reason of labour difficulties—allow the growth of weeds, leguminous plants and even grasses in their cultivation.

The studies of the effect of grasses on orchard crops at Woburn and of the effect of one crop on another in India are known and are of value, but little on this subject has been carried out in the Tropical Colonies and Protectorates. In Ceylon in several, particularly the wetter, areas coconuts are allowed to become covered with a grass like pasture. Ploughing in these areas may not be practicable, but it has become general in others

and increased crops have resulted. In yet others ploughing and frequent disc-harrowing to keep down all weeds have given initial increases in yields at the commencement to be followed by subsequent deterioration of crops. In these areas, clean weeding by means of implements has been abandoned and if humus content of the soils is to be maintained, too frequent cultivations, under the conditions of soil and climate then prevailing, cannot be practised. In rubber the use of creeping cover crops to prevent soil erosion is becoming general. What effects will such crops have on rubber yields and what the correct agricultural measures for dealing with such crops have yet to be ascertained. The growing of *Desmodium triflorum*, a small clover-like cover plant, is reported to have been detrimental to the growth of young tea, but this is probably because it was allowed to form a close carpet-like growth and was not forked or otherwise dealt with. In old tea, the growth of high light shade is common throughout Assam, whereas in Ceylon the general practice is to grow low lopped plants about 8-12 feet in height. There is undoubted evidence of the value of growing such shade in tea in both Assam and Ceylon, and whereas the humus content of the soil may be maintained thereby it is more probable that the beneficial results may be due as suggested by Howard, to the deep rooting systems of the shade trees providing for more satisfactory soil drainage.

In the tropics, it is generally considered that the growing of leguminous green manure crops in the permanent products is sufficient. The treatment of the crop in order to secure soil improvement is not yet understood nor adequately worked out, neither has the effect of such a cover crop on the permanent product been accurately ascertained. Experiments designed to secure some data on this latter point have been laid down to study the effect of growing a leguminous cover crop (*Indigofera endecaphylla*) on a growing tea crop in the Experiment Station, Peradeniya.

The whole question is however a matter of some importance to Tropical Agriculture and it is suggested that co-ordinated research work in various Colonies should be inaugurated.

Memorandum V.

Soil Erosion.

From the Department of Agriculture.

In hilly portions of the Tropics much material damage has already been done by soil erosion. In Ceylon much of our fertile top-soil has found its way to the sea and many of its hill slopes have become badly washed and grass covered. In recent years, the situation has been realised, and determined efforts are being made to repair some of the damage of the past and to prevent further loss of soil in the future.

The first attempts in Ceylon to prevent soil erosion in tea and rubber cultivation consisted in the provision of contour drains. Gradually the number of such drains was increased, their slopes decreased and in recent years the provision of an adequate number of silt pits either in conjunction with the drains or independent of them has been made. In rubber cultivation, low stone walls were built on the contours and in many situations the terracing with stone walls of individual trees was resorted to with advantage. In the opening of new lands, the planting of contour hedges of leguminous plants was occasionally practised. In 1923 the Department of Agriculture not being satisfied that sufficient was being done to prevent soil erosion launched a campaign dealing with the question. As a result much has been accomplished in recent years. In the opening of new lands various forms of terracing has been experimented with and the system of contour platform terracing combined with the growing of leguminous cover crops is now commonly adopted in the opening of new areas. The provision of silt pits throughout all the areas of tea and rubber has become general, contour walls of stone are being continually built and contour planting of leguminous plants in the form of hedges is increasing. The result of these works are being closely watched by the Department, which is freely consulted on questions affecting soil erosion, and the growing of green manure crops. A carefully planned experiment has been inaugurated on the Experiment Station, Peradeniya to test the amount of soil erosion which is taking place and the effects of certain ameliorative measures. These experiments have been designed to represent existing tea cultivation in Ceylon and the first year's measures showed that ·17 acre-inches of top soil had been lost. Further figures will however shortly be available. This experiment is only on a small scale owing to the insufficiency of available lands but it should afford figures of value and it is suggested

that similar experiments might be undertaken in those Tropical Colonies and Protectorates on whose hilly slopes soil erosion is considerable. Photographs and lantern slides of work in Ceylon designed to prevent soil erosion will be sent to the Conference and a special article has recently been written by request for the Empire Forestry Journal.

Memorandum VI.

"Shifting" Cultivation.

From the Department of Agriculture.

It is suggested that the work which has been done and is being done in the various Colonies and in India with a view to replacing "shifting" cultivation by permanent holdings with the necessary rotations of crops should be collated and the experience of various countries compared.

The replacement of "shifting" cultivation by a more permanent form of agriculture is essential to the welfare of many tropical portions of the Empire. Not only is such a method of exploitation wasteful of forest but it leads to soil deterioration and frequently to the formation of "waste." In Ceylon, this system of "shifting" cultivation is common in certain dry tracts and is essential for the provision of food grains for the normal subsistence of the inhabitants. The cultivation of crops for more than one or even two seasons is not common on account of subsequent weed growth rather than by reason of rapid soil deterioration. The introduction of implemental cultivation to deal with weed growth, the establishment and marketing of money crops and the consolidation of areas are the problems to be faced in Ceylon. Money crops are being introduced into certain districts and special arrangements are being made for the marketing of crops. Consolidation of areas cleared has been accomplished in certain parts, and successive cultivation has been established in a few villages where there is a certain amount of pressure of population on the land. Five definite rotation stations have been established by the Department of Agriculture in four different districts to test out the most remunerative crops and the most satisfactory rotations. These have been established on the lines of what is thought likely to be an economic holding for a small peasant proprietor, and detailed costings of all operations are being maintained.

Similar work is being undertaken in Nigeria and possibly other Colonies and Protectorates. In India "shifting" cultivation has in many provinces given way to permanent cultivation by

reason of " pressure of population " but in certain other areas it has been controlled and replaced by plough cultivation. A collection of the results obtained and experience gained would be of considerable value and is of the utmost importance to the development of several parts of the Empire.

Memorandum VII.

Economic Aspects Regarding the Place of Live-Stock in Tropical Agriculture.

From the Veterinary Department.

Most of the tropical estate products bring in a larger and more immediate return than can be obtained from live-stock but it must not be overlooked that a continued drain will result in impoverishment of the soil. Already estates are incurring heavy expenditure on artificial manures, naturally deficient in humus-conferring properties.

Meat and Dairy Products.

It is probable that manure more efficient for the purpose and at lower cost, could be produced on the estates by incorporating cattle-breeding and dairying operations in the estate routine.

With a proportion of one bovine animal to every three inhabitants, Ceylon is unable to supply her own requirements of either meat or dairy products.

For the meat supply of Colombo alone, approximately 3000 cattle, 500 buffalos, and 70,000 sheep and goats are imported annually from India for slaughter. In addition frozen and tinned meat and mutton and dripping to the value of approximately Rs. 500,000 were imported in 1925.

Milk and butter are scarce and dear even in the country districts. During 1925, the following dairy products were imported:—

Milk and Cream (Tinned and frozen) ...	Rs.	749,933
Butter (Frozen and tinned) ...	,,	632,802
Ghee ...	,,	288,940
Cheese ...	,,	163,173
	Rs.	1,834,848

The cattle population has remained stationary at 1,500,000 head during the past twenty years, as far as can be ascertained. This failure to increase is not due to loss from contagious diseases, nor to slaughter for food purposes, and suggests a high state of sterility and calf mortality.

The causes operating to prevent increase in the cattle population are as follows:—

Lack of pasture and fodder, deficiency of mineral elements in the pasture, indifference and ignorance of the principles of cattle breeding, lack of facilities for the collection and transport of cattle to markets, *e.g.*, the larger towns.

Religious scruples also operate against slaughtering animals.

The lack of pasture and fodder is due largely to the nature of the agricultural operations of the country, namely—paddy, tea, rubber, and coconut cultivation. To relieve the situation, the following matters require investigation:—

(1) The possibility of securing some fodder plants, which could be sown with paddy, and which grow following the reaping of the paddy, and provide a food supply during the fallow season.

(2) Methods of preserving fodder crop for use during times of scarcity in the dry season in areas subject to prolonged droughts. The development of a cheap and efficient method of ensilage would be of value.

(3) Green manures and cover crops are being extensively grown on tea, rubber and coconut estates. If some of these could be used for feeding cattle, it would relieve the situation and at the same time probably increase the manurial value of these crops.

(4) The practice of ploughing up the soil under coconuts intensifies the shortage of pasture.

Preliminary investigations show that the pasture grasses of Ceylon save in the two districts, Hambantota and Jaffna, are generally deficient in Calcium and Phosphorus. Methods of supplying these deficient minerals either by manuring pasture lands or by feeding of Bone Meat, etc., to the cattle require development.

The establishment of cattle breeding institutions for the education of the cattle owners, and for the dissemination of improved strains, is required. Information on efficient methods of bringing such knowledge within the reach of the cattle-owners is required. Co-operative movements for collection and marketing of surplus cattle and ghee from the remote districts would do much to stimulate interest in the cattle industry by enabling villagers to obtain ready cash for their at-present-unsaleable stock.

As regards the dairying industry, the native cattle are useless for this purpose.

Cattle of European milking breeds do well in the up-country districts. The lack of facilities for the transport of meat and dairy products from these districts to the large towns has limited the increase of such stocks. Cold storage facilities on the railway are required. For the development of herds of cattle of European dairy breeds, constant importations from Great Britain are necessary. The excessive cost of freight has brought importation to a standstill. The freight on a bull from England is approximately £50, almost the cost of a first-class passage. This charge is excessive in view of the fact that cattle do not occupy space utilised for other cargo; they are fed at the owners' expense, and the butcher who attends to them on the voyage receives a gratuity from the owners. Shipping companies' expenses must therefore be very small; and there is no doubt that their freight charges could be substantially reduced, and still leave a fair margin of profit. The fact that the Mail Steamship Company to South Africa carry pedigree stock free shows that considerable reductions could be made in freight charges on all classes of breeding stock.

Disease Regulations and Quarantine.

The importation of cattle from India, Aden, etc., into Ceylon entails quarantine. Uniformity in quarantine requirements between the Colonies and Dominions is desirable. Cattle disease regulations enforced in all Colonies and Dominions should be co-ordinated and those particularly successful in practice recorded and notified.

Diseases.—Foot and Mouth disease is prevalent. Should the labours of the Foot and Mouth Disease Research Committee at present at work in England result in the development of some method of preventive inoculation, their results in the laboratory will require to be checked by field work. Such work cannot be done in England. Countries such as Ceylon where slaughter is not enforced, would prove very suitable centres for the testing on a large scale of any method developed. Osteoporosis of horses is very prevalent. Investigatons in Ceylon indicate that the cause is a deficiency of Calcium in the diet, and in most cases aggravated by an excess of Phosphorus. The co-operation of other workers on this problem would be valuable.

Mycological Notes (11).

A Preliminary Note on a Mycorrhizal Fungus of Tea Roots.

MALCOLM PARK, A.R.C.S.,

Assistant Mycologist, Department of Agriculture, Ceylon.

A MICROSCOPICAL examination of the roots of many plants reveals the presence of fungus hyphae in the cells of the cortex of the smallest roots. These hyphae are not parasitic in the pathological sense of the word, since it is obvious that their presence is tolerated. The cells in which they live are not killed, as would be the case if the fungus were normally parasitic, but, on the other hand, it is seen that the hyphae which have penetrated most deeply into the cortex of the roots are themselves altered and broken down by the action of the host cells. Roots of this nature are known as *mycorrhiza* and the co-existence of plant and fungus is known as *symbiosis*. Mycorrhiza are of two types. In one case the fungus forms a sheath of hyphae on the outside of the root which acts as an absorbent layer instead of root-hairs. This type is known as *ectotrophic mycorrhiza* and is characteristic of forest trees such as pines, larch and birch. In the other type, the fungus hyphae are found inside the cells of the root with only isolated hyphae passing into the soil. This type is known as *endotrophic mycorrhiza*. A mycorrhiza in which the two forms are present together is *ectendotrophic*. In this note it is proposed to deal only with *endotrophic mycorrhiza*.

The concensus of scientific opinion is that the symbiotic relationship of plant root and fungus in mycorrhiza is of mutual advantage in that the plant supplies the fungus with carbohydrates produced by the process of photosynthesis, while the fungus, when it is absorbed in the inner cortex of the plant, supplies readily available combined nitrogen. In this respect the arrangement is somewhat analogous to that in the bacterial nodules of the roots of legumes, although it is unlikely that mycorrhizal fungi are able to utilise atmospheric nitrogen. Rayner, who has done much work on the subject of mycorrhiza

states (1): " In the opinion of the writer, there can be no doubt " that recent investigations by means of pure cultures have tend- " ed to support the view that the possession of mycorrhiza is " frequently of benefit to the vascular hosts, the nature and ex- " tent of such benefit depending upon the physical conditions of " the environment and the physiology of the association in in- " dividual cases."

In extreme cases the symbiosis is obligatory, the best examples being found among the orchids. These plants cannot be grown unless they are associated with their specific mycorrhizal fungi. It is of interest to note that the mycorrhizal fungi of the orchids are of the *Rhizoctonia* type and that the fungus associated with one genus may not be able to assume the symbiotic relationship with another genus, although both the plants and the fungi concerned may be closely allied systematically. From this extreme specialisation there is a range of gradations to the mycorrhiza of the majority of plants and trees in which the symbiosis does not appear to be essential for normal development.

In November, 1924, the writer had occasion to examine small roots of tea bushes in connection with the investigation of a disease of tea and he noted at that time the presence of mycorrhizal hyphae. Attempts were made to isolate the fungus from young tea roots. The process is difficult since, as has been mentioned above, the hyphae of the fungus are altered by the action of the host cells, and it is only from a fresh infection that the fungus can be readily isolated. It is also difficult to sterilise the surface of very small roots in order to avoid contamination by saprophytic organisms without affecting the mycorrhizal fungus, for the latter is most active in the superficial layers of the cortex. A fungus of the *Rhizoctonia* type, however, was isolated and obtained in pure culture, but owing to pressure of other work the investigation had to be abandoned. In 1926, Tunstall (2) recorded the presence of mycorrhiza in tea in Assam, but did not publish more than a notification of their presence. Sampson (3) recorded the presence of mycorrhiza in the coconut, and their presence has been confirmed in Ceylon, while an examination of the healthy young roots of *Hevea* has also disclosed the presence of fungus hyphae in the cortical cells. It is proposed to carry out further investigation of roots to determine the presence or absence of mycorrhiza in a number of plants.

Recent attempts have been made to establish the identity of the mycorrhizal fungus of tea with a certain amount of success. The fungus obtained in 1924 has been isolated again, and it would seem that it is the most promising isolation. The fungus is of the *Rhizoctonia* type and is similar in morphological characters to certain strains of *Rhizoctonia bataticola*. Other fungi,

however, have also been isolated, and further investigation is necessary before a definite statement regarding the identity of the tea mycorrhizal fungus can be made.

Concurrently with the isolation experiments another line of investigation has been followed. Roots of tea ranging from one inch in diameter down to the smallest were cleaned thoroughly; all diseased and discoloured portions were removed and the surfaces were thoroughly sterilised by immersion in corrosive sublimate solution. After washing, the roots were buried in soil previously sterilised and kept in a moist condition. After an interval of five months, the roots were dug up and examined. A number of fungi were found on and in the cortex of the roots, including *Fusarium*, *Gloeosporium*, *Diplodia* and *Rhizoctonia bataticola*. All the fungi found, with the exception of *Rhizoctonia bataticola*, are common air-borne saprophytes, and it is possible that the presence of *Rhizoctonia bataticola* is significant. It was realised that this experiment was unsatisfactory and a further controlled series has been set up to determine, if possible, if *Rhizoctonia bataticola* is present in apparently healthy roots.

As this article is an account of preliminary work only, the following suggestions are put forward tentatively. In a mycorrhiza the host plant and the fungus are living together in a state of equilibrium. The fungus hyphae are broken down by the plant if they advance too far. It is obvious, however, that the fungus is parasitic up to a point and certain workers have gone so far as to state that the symbiosis is a condition of suppressed parasitism which is of little or no value to the host plant. There is no doubt of the state of equilibrium, and, if the balance of power is disturbed in any way, that is to say, if the resisting power of the plant is weakened, then the fungus will progress as a parasite or, in the extreme case of previous death of the host plant or the part affected, as a saprophyte. There are a number of conditions which may affect the resisting power of the plant, such as unfavourable soil conditions, mechanical injury, or the attack of another parasite on another part of the plant.

Recently there has been considerable discussion as to the cause or causes of root disease in Ceylon. *Rhizoctonia bataticola* has been found associated constantly with a variety of conditions resulting in death of tea-bushes. In the great majority of cases of death due to root disease the presence of *Rhizoctonia bataticola* has been noted either alone or in association with other fungi. It has been suggested on the one hand that *Rhizoctonia bataticola* is the primary cause of root disease and on the other that it is a common soil saprophyte. In view of the differences in symptoms, rate of death and localisation of affected bushes the former theory has been questioned, while the positions in which sclerotia of

Rhizoctonia bataticola are found on diseased and dying bushes have tended to indicate that the fungus cannot be other than parasitic. If *Rhizoctonia bataticola* is the mycorrhizal fungus of tea, then there is an answer to the arguments of both sides. The fungus is present in the roots all the time and it is suggested that, given a condition, either physiological or pathological, which is unfavourable to the bush, the fungus is able to get the upper hand and to proceed as a parasite, eventually forming sclerotia in the dead tissues. At present there is but little direct evidence in support of this suggestion but it is of a positive nature, and it is hoped that further work will produce results of such a nature that the issue will not remain in doubt. If the premise that *Rhizoctonia bataticola* is a common and constant mycorrhizal fungus of tea is correct, an investigation into the conditions which influence adversely the host cells and enable the fungus to act as a normal parasite may lead to results of economic value. On the other hand, the mycorrhizal fungus may be of value to the tea bush and its absence under certain conditions may lead to unsatisfactory development.

To carry the argument a stage further, it is also possible that the same conditions affect other plants. It has been shown by a large number of workers in recent years that the mycorrhizal habit is extremely common throughout the vegetable kingdom, and it may be possible to demonstrate that *Rhizoctonia bataticola* is one of the commonest mycorrhizal fungi and that it is only after the operation of conditions resulting in the death of the host plant or the part of the host infected by the fungus that it becomes evident macroscopically by the formation of sclerotia. In conclusion it may be pointed out that, if certain of the possibilities recorded above are confirmed, the contributory conditions which lead to the advance of the fungus must be considered as of relatively greater importance than the fungus itself in cases of *Rhizoctonia* root disease of tea. A knowledge of the contributory conditions may lead to a means of avoiding *Rhizoctonia* root disease.

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Selected Articles.

The Deterioration of Soils.

F. HARDY

Natural Soils

NATURAL fertile soils, such as forest soils, and prairie soils, differ from the rocks from which they were derived mainly in that they contain plant residues and in that they teem with micro-organic life. Plant residues contain considerable amounts of inorganic salts (lime, potash, phosphate), derived orginally from rock debris, and concentrated in the surface layers of the soil through the growth, death and decay of plants. Plant residues also yield a material usually called "humus" which is highly carbonaceous and highly nitrogenous. Humus provides a very suitable feeding ground for certain micro-organisms (the "nitrifiers") which convert its nitrogenous matter into nitrates and other simple nitrogen-compounds that can readily be absorbed by plants. Moreover, certain other micro-organisms (the "nitrogen-fixers") can actually maintain the nitrogen content of the soil by fixing atmospheric nitrogen in their bodies, and leaving it behind when they die. For successful growth, these beneficial micro-organisms require suitable conditions, such as adequate air supply, adequate water supply and absence of acidity in the soil. They derive much of their food material from the soil humus. Besides furnishing salts (lime, potash, phosphate), nitrogen compounds, and food material for useful micro-organisms, soil organic matter possesses very desirable mechanical properties which confer high water-retentivity and great ease of water movement on soil containing it. Hence, in general, soil fertility is directly proportional to the quantity of normal organic matter present in a soil.

When natural fertile soils are brought into cultivation by man, they at once begin to deteriorate. The removal of their covering of vegetation exposes the soils to rain, sun and wind. Erosion rapidly proceeds, especially if the land be sloping, and if not proper surface drains have been dug. The fertile top soil is partly washed away, and the accumulated salts are leached out. Sun and air encourage rapid loss of organic matter by oxidation, and the conditions of micro-organic life are profoundly disturbed. Eventually, a raw, lifeless, mineral remnant of the original soil, differing but little from the parent rock from which the soil was derived, is all that is left. This uncompromising material can no longer be described as soil.

Soil Conservation.

The art and science of agriculture aim at preventing or counter-acting these disastrous changes. It is good agricultural practice to prevent soil erosion; to minimise leaching or to make good its depletions by tillage and manuring; and above all to conserve soil organic matter or to maintain its store by returning all available residual organic matter to the land, and by burying cover crops deliberately grown for the purpose.

Soil Robbing and Soil Building.

The policy of soil robbing has led to serious economic crises in many countries. Thus, Sir William Crookes at a British Association meeting in England in 1898, predicted a serious world famine in 1930, unless greater care were taken to lessen soil deterioration in wheat-growing countries. His warning directly led to the birth of the great atmospheric nitrogen industry, which nowadays produces thousands of tons of synthetic fertilizers yearly. It also led to greater attention being paid to the scientific aspects of agriculture. Nevertheless, in spite of conspicuous progress, once more warnings of over-population and impending food shortage are being sounded. Practically all the good agricultural land, available without expensive reclamation or developments in communication, is already in use, and the problem of soil productivity is nowadays even more serious than heretofore. It is gratifying to learn, however, that analyses of crop yield statistics in Europe and in America indicate that no general decline in production has occurred since good agriculture became the rule rather than the exception (*See Jour. Amer. Soc. Agronomy,* Feb, 1926). Most authorities are in agreement that even poor and low yielding soils can be built up into highly productive soils by diligent and continued attention to the well-established principles of modern agriculture. The constructive research of agricultural investigators, and the teachings of science, have undoubtedly exerted profound effects during the last half century, and have resulted, not only in soil maintenance, but also in actual increase of production of agricultural commodities per unit of land throughout the world.

Economic Considerations.

Whilst the means to desirable ends are generally well known to present-day crop growers, their thorough application in any particular area is often a difficult matter, because of the restraint to activity furnished by fundamental economic conditions. The success of agricultural endeavour is gauged by the magnitude of the monetary profits. Nevertheless, economic conditions fluctuate enormously from period to period, and the successful crop-grower must be capable of adapting his practice to prevailing circumstances. For this reason, inertia and conservatism are fatal to agricultural progress, both individual and communal.—*Tropical Agriculture.* Vol. IV. No. 12. 1927.

Manuring of Hay and Pasture.

THE following is an abstract of Leaflet No. 37 on Manuring of Hay and Pasture, issued by the Department of Agriculture, Dublin, August, 1927 :—

In the Irish Free State the economic importance of the proper treatment of Meadow and Pasture Lands has been readily recognized by the fact that there is a vast acreage of land under old meadow and rotation hay. The yield and quality of the herbage of the hay crop saved on a large area of the meadow land are extremely poor. Even in the case of rotation hay much could be done to increase production and improve the quality of the crop. A crop of hay removes a considerable amount of manurial ingredients from the soil and in the absence of manure the land can continue to produce successive crops in reduced quantity at the cost of soil deterioration. In view of the scanty yields obtained in many cases from much of the land under meadow hay and the beneficial results which a moderate dressing of manure will almost invariably produce on the quality and yield of the hay, as well as on the after grass, the proper manuring of this crop calls for no less attention than does the manuring of roots, potatos or grain crops.

Experiments were carried out with farm-yard manure and artificial manures and the most satisfactory results were obtained from a complete dressing consisting of—1 cwt. Nitrate of Soda, 2 cwt. Superphosphate, 3 cwt. Kainit per Statute Acre. On most farms the available supply of farm-yard manure is, as a rule, required for root crops and in such circumstances artificial manure is to be relied upon. In the experiment just referred to the superphosphate and Kainit were applied about the end of February, and the Nitrate of Soda about the beginning of April.

In subsequent tests a dressing was used consisting of 1 cwt. Sulphate of Ammonia, 2 cwt. Superphosphate, 3 cwt. Kainit per Statute Acre. The three manures were mixed together and applied on adjoining plots, at intervals of a month, from early January to early April. The mixture with sulphate of ammonia may, under average conditions, be substituted for the standard mixture with Nitrate of Soda, and its use obviates the necessity for applying the nitrogenous manure as a separate dressing.

With regard to the use of liquid manure for meadow hay in winter and early spring experiments showed that a dressing of 16 tons per statute acre have produced an average increased yield of 17 cwt. of hay per statute acre, an increase exceeding that produced by the application of an equal weight of farm-yard manure.

Experiments with the principal phosphatic manures now available and the three mineral phosphate Gafsa, Algerian and Naura, and the different kinds of basic slag have shown a distinct increase over the unmanured plots. The increased yield of hay and the enhanced value of the after-grass during the first season following the application of artificial manures will, in almost every case, be sufficient to pay the cost of the manures.

For many years past the raising of store cattle for export and the production of milk and butter have been the chief branches of the Irish livestock industry. The farmer has learnt from experience that tillage crops cannot be raised successfully without the aid of manures. He has failed, however, to realize that the raising of cattle for export for generations past has been a serious drain on the fertility of the land on which the stock is pastured and, on large areas of such land, no steps whatever have been taken to restore the fertility which has been lost. To make matters worse the pasture on which store cattle are raised are, for the most part, those on which dairy cows are pastured and have to be maintained during the period of maximum milk production.

Phosphate of lime, the most valuable mineral manurial constituent of soils, is required in comparatively large quantities by growing animals for the building up of their bodies, and by dairy cattle for the supply of the requisite mineral matter for the production of milk. This explains the reason why stock farming, as it is commonly practised, "wears out" pasture land in the course of time unless some of the plant food constituents have been restored. It also indicates the nature of the treatment which such lands should receive in order to maintain their stock carrying capacity.

What has just been written makes it clear that the surest method of restoring and maintaining the fertility of pasture land is the application, in some form or other, of phosphate of lime. Superphosphate, basic slag and ground mineral phosphates are the principal fertilisers which supply phosphate of lime. While good results have been obtained from the use of all these fertilisers on Irish pastures, high grade, high soluble basic slag has hitherto been the most extensively used throughout the country. The remarkable improvement which follows its application to poor grass lands is convincing evidence of the extent to which the reserves of phosphate of lime in the land has been depleted.

Farmers sometimes allege that repeated dressing of slag do not act as well as first applications and will eventually have no effect whatever. This is not borne out by the results of experiments extending over twenty years at, among other places, Cockle Park, England.

The importance of improving the milking-strain of dairy herds and the quality of store and beef cattle and sheep is fully recognized at present, and determined efforts are being made to effect improvements in those directions. Unfortunately it is not so clearly realized that in order to achieve the fullest possible measure of success in the improvement of livestock it is essential to restore and maintain at a high level the fertility of second and third class grazing lands. No animal, however well bred, can economically produce milk, beef, or mutton on impoverished pastures. Poor pastures are incapable of supplying, at any period of their growth, the necessary food constituents for the maintenance of a cow producing three gallons of milk daily. As a result of the information gained from more than twenty years' experimental and demonstration work on the improvement of pastures, the means whereby the returns from live stock can be increased to an appreciable extent are now definitely known. It will be found that the money spent on phosphatic manures for application to poor pastures will give a much greater return in the production of natural food for live stock than if the same amount was expended in the purchase of feeding stuffs.

The Rice Question.

THE Philippine rice farmer is now facing a situation not known before in this country. That is, the price of rice is lower than has ever been known. At the present price it will no longer pay to produce rice under the existing conditions in our farms. The people are greatly alarmed. Every day the newspapers are filled with items concerning the rice question. Solutions are being sought for the present problem. Many are thinking of a possibility of exporting rice. A petition has been sent to the Acting Governor-General asking him to lift the ban on exporting rice which has been in effect since 1919. Mr. Fidel Reyes, Director of the Bureau of Commerce and Industry, has written a very strong letter to the Acting Governor-General urging the lifting of the ban.

Opinions, however, differ as regards the possibility of exporting rice. It is believed by some prominent rice dealers that it is quite impossible to export Philippine rice to foreign countries, as China and Japan. It is said that it would be necessary to reduce the price of rice to at least P6 a cavan if it is to be exported to China. Rangoon and Saigon rice sells in the neighbouring markets at P8 a cavan and considering the cost of transportation and the high tariff duties in Chinese ports it would be quite impossible for Philippine rice to compete at that price. A wealthy rice dealer said that "it needs a very serious study of the situation before we ever attempt to export rice."

In considering the question of exporting rice or in other words increasing the price of rice, another phase of the question should be considered. While it is true exportation may benefit the rice growers, what about the producers of the coconut, the abaca, the tobacco. They are all rice consumers and if the price of rice goes higher these people will be greatly affected. So that the price of rice must not be increased to an extent that will be detrimental to these crop producers. This was well explained by Senator Juan Alegre in his argument against the lifting of the ban. He stated that at one time rice in the Bicol region sold as high as P25 a cavan.

The Bureau of Health prepared a memorandum opposing the lifting of the ban. The memorandum states that the lifting of the ban would tend to decrease the amount of unpolished native rice and increase the importation of polished rice from Saigon. The Bureau claims that the Saigon rice is devoid of vitamins and, when used in the diet to a certain degree, causes beriberi. The memorandum further states that beriberi is third among the diseases in point of prevalence and mortality and that the lifting of the ban in no very long period may make the disease the most dangerous in the Philippines.

Another remedy offered to improve the rice situation, is to decrease production. One of the victims of the low price of rice is a graduate of the College of Agriculture. He is so dissatisfied with the present situation that he is considering growing other crops. He says that there are quite a number of rice farmers in his locality who are contemplating planting sugar-cane instead of rice. He, himself, is looking for a place where he

can invest in fisheries. He is planning to go to Mindora where he expects to find the place he wants. He says that if those who are contemplating changing their crop to sugar-cane push their plan through it would mean a reduction of rice production and may result in better prices.

The present situation seems very interesting from an economic point of view. The price of rice is very low. People are thinking of exporting rice. But, has the Philippines produced enough rice to feed the whole Filipino people? It has not. We are still importing millions of pesos worth of rice. Millions of sacks of Saigon rice is still coming to Philippine soil. We have no right to talk of over-production. It has not yet come. The present problem is a problem in agricultural economics. It is a simple economic phenomenon governed by an economic law. There is a break in the economic balance which has resulted in this economic disturbance. Too much of one kind of commodity has been produced in one region, but though it could be consumed by the people of the archipelago, it has been impossible to distribute it evenly. Thus the inability of even distribution of the commodity has resulted in the over-stocking in some regions and consequently an abnormally a low price. This is the cause of the rice situation.

Other questions may be asked in this connection. Why can foreign rice compete with our rice in our own country in spite of the tariff levied on imported rice? Can it be that there is something wrong with our tariff on rice? Could the consideration of our rice tariff have any bearing on our rice problem? Such questions are worth considering.—*The Philippine Agriculturist.* Vol. XVI. No. 7. 1927.

Calf Rearing on Modern Lines.

Correct Temperature of Food Essential if Scour is to be avoided—Some Substitutes for Cream in Milk Foods.

SPEAKING to a large gathering of Lancashire farmers at Burnley, on Monday, on calf rearing, Mr. C. T. May, M.A., of the county agricultural staff, said it was a great handicap to a calf to be fed only twice a day, and it was infinitely better to supply three meals, which would certainly reduce the risk of scour. When fed only twice a day the stomach was empty an hour or so before each meal, and was probably too full an hour or so afterwards. Thrice daily feeding, if only for a few days, would be a great advantage.

He felt sure it was through lack of care that scour was so prevalent at the present time. To safeguard against this trouble two important precautions must be taken. The first was the temperature of the food supplied. The temperature of a cow and therefore her milk was 101 degrees Fahr., and a calf fed with milk above 104 or below 94 was liable to scour, and the younger the calf the more likely this trouble. It was preferable to feed a little too cold than a little too hot. In cold weather it might be difficult to keep the food within the narrow limits he had named, but it was important every effort should be made to observe it.

A second important point was that the milk should not be taken in gulps during the first few days, and this should be avoided by allowing the calf to draw the liquid between the fingers. Where a number of calves were reared a good plan was to use a bucket fitted with a rubber teat. This receptacle was secured in the pen at the right height for the calf to drink. The cleaning of this utensil gave trouble, but it saved time and had other compensations.

Whole Milk at First.—The speaker stressed the importance of feeding whole milk for the first three weeks whenever possible. At the end of that time the calf was big and sturdy enough for a gradual change to be made to separated milk and a cream substitute. The change should take a fortnight. There was a wide range of cream substitutes, and almost any sugar, starch, oil or fat that was easy to digest and could be supplied in a finely divided state would do. He had known good calves reared on lard and separated milk. Cod liver oil, which was largely used, was comparatively cheap, but it was not very easily digested, and at first a calf could not utilize properly more than 2 oz. per day.

To each gallon of separated milk ¾ lb. of ground oats gave very good results, and was easy to feed. The oats were fed dry and not necessarily at the same time as the separated milk. To start the calf on this feed a

little should be put in the bucket when the milk had almost been consumed. As soon as the calf had got in the way of taking this food it could be supplied in the dry state. Crushed oats similarly fed had proved very successful. It should be given at the rate of about 1 lb. to each gallon of separated milk, and when the calf was five or six weeks old 1 part in 15 to 1 part in 12 of white fish meal should be added. Fish meal was of the greatest importance in the lime-lacking districts, as it supplied the bone-making material the calf most needed at this stage. These methods of feeding had given much better results than gruels or other cooked foods, effected a good deal of saving in labour, and minimized to a considerable extent the risk of scouring.

When Whey is Available.—When whey only was available, much greater care was necessary in feeding, and the growth was never so good. If calves did half so well on whey as on separated milk that was all that could be hoped for. Foods that had given the best results with whey were:—(1) Palm kernel cake, (2) equal parts of linseed cake meal and bean meal, (3) two parts of ground oats and one part of fish meal. To each of the first two feeds half an oz. of precipated phosphate of lime should be added to provide bone-forming material. The whey should be as sweet as possible, because it was largely due to the acidity it contained that made it less suitable for rearing calves.

At the age of five or six weeks the calf would begin to eat a little hay, which helped to develop the first stomach. At 3½ to 5 months old separated milk could be withdrawn gradually. From this time it would be getting 1 lb. to 1½ lb. of mixed cakes and meals, 4 lb. to 6 lb. of hay per day, and 7 lb. to 10 lb. of swedes or grass until about twelve months old. At this age a wide range of cake and meals was available, but one of the least suitable was cotton-cake.—*The Farmer and Stock-Breeder and Agricultural Gazette.* No. 1990, Vol. XLI, Monday, November 28, 1927.

Why Milk Yield Varies.

Some Factors Which May Account for Day-to-day Fluctuations.

W. D. THOMPSON.

FLUCTUATING yields are complexing and worrying. They spoil records, shake the cowman's confidence in his ability, and upset arrangements for the disposal of the milk. Investigations may prove disappointing in that they give no immediate results, but are never wholly unprofitable, as interesting new facts are constantly being revealed, often to become useful later.

When a whole herd is milking just anyhow the cause is usually fairly easy to find. One of the chief of these is the weather, especially during the summer and autumn. During July, for instance, we had many wet days with sunny periods. When the sun comes out after rain, it stirs to activity myriads of flies. Chased about the fields, the cows get no peace and down go the yields. When cool breezes follow a day or two of thundery weather, the cows graze and rest and the yields go up in consequence. It is both interesting and instructive to keep, in conjunction with the record sheet, daily notes on the weather.

Water and Change in Rations.

The watering and bulk feeding of the herd are often responsible for bad fluctuations. If cows are moved about from good to bad pastures where some days they have ample water and other days are short, noticeable fluctuations are to be expected. Then there is the influence of feeding. Where it is the custom at intervals to buy in different brands of cakes and meals—according to current values—there is sure to be some difference in feeding values and composition, which will undoubtedly send the yields up or down. Also, if only small lots are bought in at a time, it may often happen that supplies will get so short that the cowman has to cut allowances, with damaging results to the yields. In the winter months there may be experimenting to test different systems and rations; if feed changes are too often or too suddenly made, uneven milking will result.

Rough Handling Disturbs Yield.

Another cause, sadly too common in some herds, is rough usage of the cows. They are chased in from the fields by men and dogs, and in the byres, shouted at and abused until they hardly know which way to turn for relief. One cow getting into the wrong stall will upset a whole herd which is thus treated. When turning out, the cows are hustled and thrashed lest they make the byre filthy, and some may have nasty falls. A constant repetition of this treatment adversely affects yields.

Where an individual cow is milking inconsistently, the first query should be "Is the milker suiting her?" This is not necessarily a slur on the milker, as certain cows respond better to some milkers than to others.

It is always best to let milkers have the same cows so far as is practicable. Man and beast thus get accustomed to each other and the milking goes smoothly. Not so where the milkers take the cows as they come. Bad-tempered men soon get out of patience with nervous fidgety cows, and the ensuing disturbance upsets the rest of the cows.

Causes Sometimes Obscure.

Occasionally herdsmen are puzzled by sudden big fluctuations, some of which are never accounted for; but it is often surprising what an interested observer may discover. Some cows have the tantalising habit of lying down just when it is turn to be milked, and if the milker startles them into rising hurriedly they may be temporarily upset and fail to milk normally. Other cows, usually free milkers, sometimes run much of their milk when lying down; they should be milked as early as possible in the milking.

Very nervous cows often become so preoccupied with the milker's actions that they hold back their milk, I have found it helpful to give them something tempting to eat whilst being milked, and to put the quickest milker on them. In a byre with through mangers without partitions, I found that a cow which was going up and down in yield was sometimes having her cake stolen by her neighbour. In the winter a point should be made of seeing that timid cows get their fill at the water trough, and at the yard racks if yard-fed. Then with thin skinned, poor constitutioned cows, one has to consider the effects of sudden weather changes.

Recently I had a cow drop quite suddenly from four gallons a day to two and a-half gallons. The low yield lasted for three days and gradually returned to normal in a week. None of the above factors was solved and oestrum was out of the question. The problem has yet to be solved. About the same time another cow, a real tartar to milk, had a phenomenal drop. She was averaging about 33 lb. daily—giving 13-14 lb. in the afternoons. One afternoon the milker, admittedly under provocation, punched her rather heartily in the stomach. She had had similar treatment before without unduly upsetting her, but this blow must have landed on a milk vein, for she gave only 9 lb. that afternoon and the next morning was down exactly a gallon. She continued to give a gallon and a-half short of her normal yield for four days. On the fifth day there was an improvement but she never quite regained her former yield. This cow was exceptionally nervous, and it is interesting to note the result of a single punch, and also to realise what a mysterious case this would have been if no one had seen the punching.—*The Farmer and Stock-Breeder and Agricultural Gazette.* No. 1990. Vol. XLI. November, 1927.

The Need for a Village Dairy Factory System in India.

W. SMITH,

Imperial Dairy Expert.

BEFORE dealing with this question in the light of India's requirements, it is worth while to study briefly what has been found necessary in the direction of dairy factory development in other countries in the world outside of Asia. The result of such a study reveals some remarkable facts and clearly proves :—

(1) That all the more modern countries in the world outside of Asia, farmed by small-holders, have greatly developed the dairy industry within the last half century.

(2) That all the foremost dairying countries in the world, whether farmed by large or small-holders, have adopted a system of village dairy factories.

(3) That those small-holding countries which have increased their wealth by the development of the dairy industry have adopted the co-operative type of dairy factory organization.

(4) That in countries of small-holders, in no case was any real progress made in the improvement of the dairy cattle until after the dairy factory system had been firmly established. In other words, the permanent improvement of the dairy cattle of the country was not possible until the dairy factory system had proved to the cow-owner the potential value of the heavy milking cow.

In the first place let us look at those countries of the world which have made the greatest progress in the advancement of agriculture during the past fifty years. They are Great Britain and Ireland, France, Germany, Norway, Denmark, Sweden, Holland, Belgium, Italy, Finland, United States of America, Argentine Republic, South Africa, New Zealand and Australia. Dairy development on a gigantic scale has taken place in every one of these countries, and without exception they have adopted a dairy factory system.

The most up-to-date small-holding parts of the world to-day are Denmark, Ireland, Holland, Sweden, Finland, Northern France, Nothern Italy, Latavia and Lithuania, and by comparison with other Colonies, New Zealand is rapidly becoming a country of small-holders. In every one of these countries where a great part of the land is divided into small lots and farmed by peasant proprietors, dairying has been the main line of development and the co-operative village dairy factory is almost universal.

In all the dairying countries in the world, whether farmed on a basis of small-holdings or large farms, the village factory is universal, and it is a remarkable fact that in every case the establishment of the dairy factory system was the forerunner of that great movement for the improvement of dairy cattle which has swept over the world within the last half century, and which in the more advanced countries like Holland, Denmark and Great Britain has more than doubled the efficiency and profit earning capacity of the *average cow.* This fact when considered is only reasonable. Milk is such a perishable article, its handling for sale and its manufacture into edible and storable products is such a highly technical matter that the small producer of milk in any part of the world cannot possibly deal with the small quantities he produces and it took the village dairy factory to prove to the cow-owner the commercial value of the milch cow and the added profit which cows of improved efficiency would mean to him. Not only so, but the creamery or the village dairy factory, especially when worked on a co-operative basis, provided a means whereby the agricultural propagandist could get into direct touch with the cow-owners and bring home to them in their collective capacity as owners of a milk factory and in their individual capacity as milk producers the benefits of improved cattle-breeding, feeding and management.

India does not differ fundamentally from those other countries mentioned. She owns something like 100,000,000 adult cows and female buffalos, most of them grossly inefficient as milkers and most of their owners technically ignorant of the first principles of scientific milk production. Whenever there is sufficient milk produced to support it, we need the co-operative dairy factory in India more than any other country to:--

(*a*) Educate our cattle owners as to the value of the milk they now produce and the necessity of producing more milk;

(*b*) Secure for the milk producer the profits from the milk industry;

(*c*) Improve our methods of breeding, feeding and rearing of cattle;

(*d*) Improve our methods of handling milk for urban consumption;

(*e*) Improve our methods of manufacturing milk products.

Indian dairy factories need not be expensive or elaborate, but they must be efficient and up to date. In some cases they might be worked by hand power as was done in the case of the earlier creameries in Western Siberia.

There is no use attempting to teach a cow-owner in a tropical country how to manufacture a conserved and marketable product from the 10 or 20 lb. of milk he produces daily. He cannot possibly do it successfully. What we must urge him to do is to unite with all his neighbouring milk producers, and under the aegis of the co-operative movement equip, manage, and work a village factory for the utilization of all the milk of the village area.

The present methods of *ghi* manufacture by individual milk producers in India are so wasteful that they are costing this country a direct wastage in butter fat alone of not less than Rs. 160,000,000 per year, to say nothing of the colossal waste that is taking place in the non-utilization of the by-products of *ghi*. There is no room in India for individual dairying so far as handling of milk is concerned, and, as has been found in all those countries in the world who have developed and improved their dairy cattle, there will be no real progress made in the improvement of our dairy cattle until a system of village dairy factories is established. Beef has little or no value here. Indian cows are not killed, and consequently all our cows must be dairy cows. The inauguration of a co-operative dairy factory system throughout the country is the first and most urgent step in the direction of Indian cattle improvement. The rural cow-owner in India must be taught the money value of milk before we can expect him to make any serious attempt to improve his methods of breeding, feeding and handling cows. This must be done here as elsewhere by means of the village dairy factory.

The Government of the Irish Free State, a country of small-holder dairy farmers, are at the present moment buying out the few proprietary creameries in that country and converting them into co-operative organizations, so convinced are they of the value of the co-operative dairy factory as an element in the economic development of the country. India lags far behind in this matter, but she must start on right lines and she cannot afford to ignore the lessons which other parts of the world have learned in the hard school of experience.—*The Journal of the Central Bureau for Animal Husbandry and Dairying in India,* Vol. I, Part 3, 1927.

Departmental Notes.

Meetings, Conferences, Etc.

The Tea Research Institute of Ceylon.

A meeting of the Board of the Tea Research Institute of Ceylon was held in the Chamber of Commerce, Colombo, on Saturday, December 10th, 1927. There were present:—Mr. R. G. Coombe (Chairman), the Hon. Mr. F. J. Smith (Colonial Treasurer), the Hon. Mr. F. A. Stockdale (Director of Agriculture), Col. T. G. Jayawardene, Messrs. John Horsfall, W. Coombe, H. Hopwood, Geo Brown, P. A Keiller and A. W. L. Turner (Secretary), and by invitation, Mr. T. Petch (Director.)

A letter regretting inability to be present at the meeting was received from Mr. F. E. Mackwood.

Finance.—It was decided to place 1½ lakhs of rupees on fixed deposit for nine months with the bank offering the highest rate of interest.

Tea Termites.—The Chairman explained that Mr. Jepson, of the Department of Agriculture, was proceeding to the United States of America, for the purpose of studying termites. The Director of Agriculture had approached him (the Chairman), to know if the Tea Research Institute of Ceylon would be willing to share the expenses with the Ceylon Government if the latter were unwilling to pay the whole of the cost.

The Board agreed to share the expenses with Government, if necessary.

Estimates.—The Chairman said that all members of the Board had received a copy of the draft estimated expenditure for 1928. Subject to a few minor alterations the estimates were approved and sanctioned.

Purchase of an Estate.—The Chairman said that since the last meeting enquiries had been made with reference to eleven estates. Amonst these was a small property in Dimbula which would, it was considered, meet the requirements in all respects.

It was unanimously decided to open negotiations to endeavour to purchase or lease this property.

Buildings and Laboratories.—The Chairman said that the sub-Committee had met that morning to consider the architect's proposals and estimates. The minutes of that meeting would be sent to all members of the Board.

Annual Report.—The Secretary was instructed to circulate his portion of the annual report to the members of the Board for their remarks.

Quarterly Journal.—The Director had obtained estimates for printing the Quarterly Journal from several firms, and recommended that Messrs. Cave and Co.'s quotation be accepted. It was agreed that final decision should be left to the Chairman and Director (Mr. Petch).

It was decided that advertisements should not be included. It was also decided that the journal should be issued free to those whose names appeared on the Secretary's register.

Agricultural Conference.—The Chairman said the Director of Agriculture had written to know if there were any particular subjects which the Tea Research Institute would like included in the agenda and whether the scientific staff would read papers or initiate discussions.

The Director agreed to read a paper at the Conference.

Agricultural Chemist.—Mr. T. Eden's agreement was ratified and the Secretary was instructed to have it stamped.

Lease of "Lindfield."—It was decided to renew the lease of "Lindfield" for a period of one year from July, 1928.

Director's Review.

The Director read the following review covering the reports of the scientific officers for September and October, 1927.

Reports of the Mycologist.—Further specimens of the Armillaria root disease of *"Albizzia lopantha"* have been received and also of the root-splitting disease of young tea plants. It is remarkable that in the latter the plants do not show any signs of disease until they are dug up. Although the tap root may be split up to the collar, the top is healthy, at the age at which the stumps are about to be planted out. Examinations have been made of the pruning cuts treated experi-

mentally, but it is too early yet to arrive at any conclusions.

Reports of the Biochemist.—The Biochemist has continued his investigation of withered leaf, and has dealt with the absorption of oxygen by damaged leaf during withering, and the differences in tannin and soluble extract between damaged and undamaged leaf. Further experiments indicate that the oxidation which proceeds during rolling is not due to the presence of micro-organisms.

Periodic examinations of leaf with a view to tracing any seasonal changes in its chemical composition have shown a distinct change in the composition of the leaf with the time from pruning. These investigations are still in progress.

The published methods of determining the total water-soluble material in the leaf have been tested, and the effect of various factors on the accuracy of these methods has been ascertained, in order that a standard method might be devised.

Reports of the Entomologist.—Experiments on the control of Scarlet Mite with a Kerosene-flour Mixture, Lime Sulphur, and Sodium Silicofluoride have been carried out. Kerosene-flour gave a control of 81 per cent. and Lime Sulphur a control of 94 per cent.

Leaf from the sprayed plots was plucked separately, rolled by hand, and manufactured separately, to determine the tainting effect of the sprays used. Duplicate samples were tested by a Colombo firm. Lime sulphur gave a distinct taint in one sample and slight suspicion in the other. Kerosene-flour gave a slight suspicion of taint in one sample. Sodium silicofluoride gave a distinct taint in both samples. The rainfall during the three weeks the experiment ran was only 0·58 inch, and therefore the maximum tainting effect might be expected. It is considered that Kerosene-flour could be safely employed. These tests have been repeated, but the results were not to hand in time for the October report.

The Entomologist has visited Maskeliya, in search of parasites of tea tortrix and has succeeded in finding out egg parasites in fair quantity. Experiments are in progress to determine whether this parasite will attack the eggs of the Grain moth, *Sitotroga Cerealella*. If it will, the latter can be used, instead of tortrix, for rearing the parasite.

The Director then submitted a programme of work drawn up for the Agricultural Chemist. The Secretary was instructed to send a copy of this programme to each member of the Board for their opinion thereon.

The Meeting terminated with a vote of thanks to the Chair.

A. W. L. TURNER,
Secretary,
Tea Research Institute of Ceylon.

Minutes of the Meeting of the District Agricultural Committee, Kegalla.

Held at Wagolla on January 24th, 1928, at 8·30 a.m.

Present.—Mr. W. E. Hobday, The Assistant Government Agent (in the chair), Messrs. F. Burnett, Divisional Agricultural Officer, N. K. Jardine, Inspector of Plant Pests, A. F. Gunaratna (Secretary), W. A. de Silva (Cadet), P. C. Dedigama Ratemahatmaya, M. B. Mapitigama Ratemahatmaya, T. B. Madana Acting Ratemahatmaya (G. & K. Korales), and a large number of Teachers, School children and villagers.

1. Minutes of the last meeting were read and confirmed.

2. The Divisional Agricultural Officer explained to the members and the General Public present the various experiments that were being carried on at the Experiment Station and the varieties of plants grown at the Station.

3. The members, School-masters, School children and others present were taken round the garden by the Divisional Agricultural Officer.

4. There was a free distribution of cuttings from yams and cover creepers. The people present were informed that they could obtain plants of fruit trees at a low price whenever they might want any.

5. The Assistant Government Agent proposed a vote of thanks to Messrs. F. Burnett and N. K. Jardine, and this was carried unanimously.

Agricultural Shows and Competitions.

The following is a summary of the Agricultural Shows and Competitions which have been arranged for this year up to date:—

Western Province.

A plantain cultivation competition for Hapitigam Korale, Alutkuru Korale South and Hewagam Korale, a vegetable cultivation competition for Siyane Korale West and Colombo Mudaliyar's division, a pine-apple cultivation competition for Siyane Korale East and a Home Gardens competition for Alutkuru Korale North.

Central Province.

Two paddy cultivation competitions for the Maha Season in Harispattu and in Yati Nuwara and one competition for the Maha Season in Harispattu and in Green manuring of paddy competitions in Harispattu, Yati Nuwara and Tumpane, and in Uda Palata, Uda Nuwara and Uda Bulatgama. School garden and home garden competitions in the Kandy district.

Small village shows will be held at Teldenila and Mailapitiya at the end of July or early part of August, 1928.

Paddy cultivation competitions for Matale South, Matale East, Gangala and Laggala Korales, and for Matale North.

Vegetable garden competitions for Kohonsiya, Gampahasiya, Udasiya, Medasiya, Asgiri, and Pallesiya pattus, and Matale East and Matale North divisions. Also a curry-stuffs cultivation competition for the Matale district.

Plantain cultivation competitions for the Kotmale, Walapane and Uda Hewaheta divisions and vegetable cultivation competitions for the three divisions, together with chilli cultivation competitions in the Walapane and Uda Hewaheta divisions. School and Home garden competitions in the Nuwara Eliya district.

Southern Province.

Vegetable garden competitions in the Maha Season for Four Gravets and Akmimana, Gangaboda Pattu, Talpe Pattu and Hinidum Pattu, Wellaboda Pattu and Bentara Walallawiti Korale.

Paddy cultivation competitions in the Yala Season for the above pattus and Korales.

Six vegetable cultivation competitions in the Gangaboda Pattu, Weligam Korale, Four Gravets, Wellaboda Pattu, Gangaboda Pattu and Morawak Korale during the Yala Season.

Paddy seed competitions for each of the above divisions in the Matara district and green manuring of paddy competitions of each of the divisions.

Four vegetable cultivation competitions one each in the Raigam Korale, Pasdun Korale East, Pasdun Korale West, and Pasdun and Kalutara Totamunes.

Five cotton cultivation competitions in Paranagam-palata, Wowgampalata and Pahalawalakada, Ihala Walakada and Moderagampalata, Magam Pattu, and West Giruwa Pattu in the Hambantota district.

Paddy cultivation competitions in the East Giruwa Pattu and Magam Pattu and a chilli cultivation competition in the West Giruwa Pattu.

Northern Province.

A chilli cultivation competition for the Jaffna district and a show for Waligamam West and North. Tobacco cultivation competition and a vegetable cultivation competition for Vanniya South.

Vegetable cultivation competition for the Mannar district.

Eastern Province.

Vegetable garden competition for Tampalkam pattu and a paddy cultivation competition for Koddiyar pattu, in the Trincomalie district.

Paddy cultivation competition for Batticaloa South, and a vegetable cultivation competition for Karavagu Pattu and Akkarapattu.

North-Western Province.

Maha Season paddy cultivation competitions for Hiriyala Hatpattu and Dewamedi Hatpattu, and also weeding competitions in Nikaweratiya, Bogamuwa and Kurunegala.

Three competitions among school gardens for the cultivation of medicinal herbs in each of the districts of Kurunegala, Chilaw and Puttalam.

A competition for the Schneider Challenge Cup among school gardens.

Agri-Horticultural and Industrial Show at Puttalam.

North-Central Province.

Four paddy cultivation competitions in each of the following:—Nuwaragampalata, Hurulu palata, Kalagam palata, and Tamankaduwa.

Sabaragamuwa Province.

Six vegetable garden competitions in each of the following:—Nawadun Korale, Kuruwiti Korale, Atakalan Korale, Kadawatta and Meda Korales, Kukulu Korale, Kolonna Korale; two plantain garden competitions, one for Ratnapura district and the other for Kukulu Korale.

A paddy cultivation competition in Kukulu Korale. Two plantain cultivation competitions in Galaboda Korale and Kinigoda Korale, and market shows at Morontota, Mawatagoda and Atale in the Kegalle district. School and home gardens competitions for the Kegalle district.

Further particulars may be obtained from the Chief Headmen or from the Agricultural Officers stationed in the respective districts.

Agricultural Department Communiqué.

Peradeniya, February 14, 1928.

Correspondence of Interest.

Manures—"Mowra-meal."

The sample of "Mowra-meal" gave the the following results:—

			%
Moisture	...	...	11·81
Organic Matter		...	81·58
Ash	...	...	6·61
			100·00
Containing Nitrogen		...	2·21

It is low in nitrogen when compared with the more widely used nitrogenous organic manures in Ceylon and it is also low in phosphoric acid.

Work done in the Central Provinces in India by Plymen and Bal shows that "Mowra" cake or meal was neither nitrified nor ammonified to any appreciable extent during a period of 8 weeks when all other nitrogenous cakes experimented with at the same time showed considerable nitrification. The authors remark "whether it is nitrified at all or not after a very long period is not yet ascertained, but as a manure, "Mowra" cake cannot be classed with the other commonly occurring cakes."

In these circumstances the import of "Mowra" cake into Ceylon is not desirable.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED 29th FEBRUARY, 1928.

Province, &c.	Disease	No. of Cases up to date since Jan. 1st, 1928	Fresh Cases	Recoveries	Deaths	Balance Ill	No. Shot
Western	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	85	33	65	...	20	...
	Anthrax	...	...	...	...	...	...
	Piroplasmosis.	4	4	3	1	...	...
	Rabies (Dogs)	1	...	...	...	...	1
Colombo Municipality	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	158	149	64	5	89	...
	Anthrax	1	...	...	1	...	...
	Rabies (Dogs)	3	1	...	...	...	3
Cattle Quarantine Station	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	1	10	7	...	10	...
	Anthrax	...	...	...	...	...	...
Central	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	47	37	32	...	15	...
	Anthrax	...	...	...	...	...	...
	Piroplasmosis						
	Rabies (Dogs)						
Southern	Rinderpest						
	Foot-and-mouth disease						
	Surra	F R	E E				
	Black Quarter						
	Haemorrhagic Septicaemia						
Northern	Rinderpest						
	Foot-and-mouth disease	F R	E E				
	Piroplasmosis						
	Rabies (Dogs)						
Eastern	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	5	3	5	...	...	...
	Anthrax	...	...	...	...	...	...
	Piroplasmosis						
North-Western	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	106	17	92	...	14	...
	Anthrax	...	...	...	...	...	...
	Piroplasmosis						
	Rabies (Dogs)						
North-Central	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	30	19	9	...	21	...
	Anthrax	...	...	...	...	...	...
	Haemorrhagic Septicaemia						
Uva	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	8	3	8	...	...	...
	Anthrax	...	...	...	...	...	...
	Piroplasmosis						
	Rabies (Dogs)						
Sabaragamuwa	Rinderpest						
	Foot-and-mouth disease	5	5	...	...	5	...
	Anthrax						

MARTIN WIJAYANAYAKA,
For Government Veterinary Surgeon.

Colombo, 13th March, 1928.

METEOROLOGICAL

FEBRUARY, 1928.

Station	Temperature: Mean Daily Shade	Temperature: Difference from Average	Mean Humidity	Mean amount of Cloud 0=clear 10=overcast	Mean Wind Direction During Month	Daily Mean Velocity	Rainfall: Amount	Rainfall: No. of Rainy Days	Rainfall: Difference from Average
	°	°	%			Miles	Inches		Inches
Colombo Observatory	78·6	—1·2	78	3·2	N	97	2·78	7	+ 0·72
Puttalam	78·4	—0·3	74	2·2	NNE	106	3·93	5	+ 2·68
Mannar	80·4	+0·4	71	3·3	NNE	194	2·80	8	+ 1·50
Jaffna	78·4	—0·6	75	4·0	ENE	80	4·38	7	+ 3·11
Trincomalee	81·2	+0·8	—	—	—	—	6·75	8	+ 4·64
Batticaloa	78·9	+0·3	78	4·2	N	179	5·15	11	+ 1·76
Hambantota	79·8	+0·8	74	3·8	ENE	295	0·69	4	— 0·74
Galle	79·6	+0·2	78	4·2	Var	117	2·31	5	— 0·57
Ratnapura	82·2	+1·1	70	4·2	—	—	3·89	7	— 0·57
Anu'pura	76·6	—1·5	76	3·8	—	—	1·99	8	+ 0·45
Kurunegala	79·0	—0·9	68	4·8	—	—	5·24	5	+ 3·64
Kandy	76·4	+0·2	68	3·8	—	—	5·84	6	+ 3·62
Badulla	70·2	—0·8	80	3·8	—	—	1·34	9	— 1·63
Diyatalawa	63·9	—1·7	75	4·7	—	—	1·67	7	— 0·70
Hakgala	60·0	—	77	4·2	—	—	6·11	11	+ 2·86
N'Eliya	56·8	—0·7	66	4·2	—	—	4·53	10	+ 2·55

Only about half a dozen stations, out of over 300, recorded as much as ten inches of rain this month. However, as the February averages are low, considerably more than half the stations beat their averages, the areas in excess including nearly all the N.W.P. and the northern part of Sabaragamuwa, and the majority of stations in the N.P., N.C.P., and the central part of the C.P.

The position at the end of February was, however, one of consistent drought, since most of the rain fell in the first half of the month and from the 14th onwards was practically dry throughout.

The highest total for the month was 13·8 at Liddesdale. Over 7 inches in a day was recorded at Meddegodda and Sangilikandarawa on the 4th, while Dunedin and Yatiyantota both recorded over 5 inches on the 8th.

Minimum temperatures were below average in every case except Batticaloa, and the amount of cloud was also decidedly in deficit. At Nuwara Eliya the minimum temperature in air got down to 31·2° on the 20th, and the minimum on grass was below freezing point fifteen times, its lowest being 24·3° on the 20th.